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Environmental Assessment for the Invasive Exotic Plant Management Program

Coronado National Forest; Cochise, Graham, Pima, Pinal and Santa Cruz Counties in Southeastern Arizona; and Hidalgo County in Southwestern New Mexico

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ABSTRACT

The Coronado National Forest proposes to develop and implement an Integrated Vegetation Management (IVM) program for the control of invasive exotic plants. The project area is located on National Forest lands in southeastern Arizona and southwestern New Mexico. This action is needed in order to meet the requirements of law, regulation and policy and because invasive exotic plants occur on and near the Coronado National Forest.

The proposed action would authorize the use of physical and cultural methods of invasive exotic plant removal as well as ground based application of chemical herbicides. In addition to the proposed action, the Forest Service also evaluated the following alternatives:

- All treatments recognized under IVM except for the use of herbicides
- No Action

Based upon the effects of the alternatives analyzed and disclosed in this EA, the Forest Supervisor will decide whether to implement the proposed management program, or to implement an alternative to the program. If the Forest Supervisor decides to implement all or part of the program, he or she will also decide when and under what terms and conditions the Forest would conduct such activities, and what measures would be needed to meet Forest Plan goals and standards and to provide adequate mitigation.

The Forest Service has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized as follows:

Chapter 1, Purpose and Need for Action. This section includes information on the purpose of and need for the project, the agency's proposal for achieving that purpose and need, public involvement and issued identified by the interdisciplinary team.

Chapter 2, Alternatives, Including the Proposed Action: This chapter provides a description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This section also includes mitigation measures included in the proposed action.

Chapter 3, Affected Environment and Environmental Consequences: This section describes the affected environment and environmental consequences of implementing the proposed action and alternatives. The No Action Alternative provides a baseline for evaluation and comparison of the other alternatives.

Chapter 4, Consultation and Coordination: This section provides a list of preparers and agencies consulted during the development of the environmental assessment.

Appendices: The appendices provide more detailed information to support the analyses presented in the environmental assessment.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Coronado National Forest Supervisor's Office in Tucson, Arizona.

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CHAPTER 1 – PURPOSE AND NEED FOR ACTION

Introduction

The Organic Act of 1897 provided for the establishment of National Forests, in part "…for the purpose of securing favorable conditions of waterflows…" The Forest Service Natural Resource Agenda for the 21st century clarified that statement to identify critical issues facing our watersheds and ecosystems including invasion of exotic species. Actions identified to implement this policy include preventing "…exotic organisms from entering or spreading in the United States". Further, the Federal Noxious Weed Act (7 U.S.C. § 2801-2814) and Executive Order 13112 authorize federal agencies to initiate control and eradication actions against incipient infestations of invasive exotic species that are introduced into this country. Federal actions such as noxious weed and invasive species eradication or control projects must be analyzed to determine the potential environmental consequences (National Environmental Policy Act of 1969).

The term "noxious weed" has legal ramifications for states that have noxious weed laws or regulations. Noxious weeds in Arizona are those species that are "...liable to be, detrimental or destructive and difficult to control or eradicate..." (ARS § 3-201). New Mexico defines a noxious weed as "a plant species that is not indigenous to New Mexico and that has been targeted pursuant to the Noxious Weed Management Act for control because of its negative impact on economy or environment" (§ 76-7-1 to 76-7-22 NMSA 1978, Doc. 17). The term "noxious weed" has been selected for use in the Forest Service Region 3 Weed Management Strategy, issued in January 1999, to pertain to invasive exotic plants that will cause adverse environmental, social, and economic effects, altering management objectives for the Southwestern Region. Forest Service policy (Forest Service Manual 2080.5) defines noxious weeds as: "Those plant species designated as noxious weeds by the Secretary of Agriculture or by responsible state official. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insect or disease and being native or new to or not common to the United States or parts thereof."

While small populations of designated noxious weeds occur on the Forest, a more significant problem is with invasive exotic species. Federal and state laws generally define noxious weeds in terms of interference with commodity uses and economic impacts; however, the impact of invasive exotic plants on ecosystem processes such as hydrology, fire frequency and plant productivity is a growing concern. Since the Coronado National Forest was established in 1908, invasive plants have increased in numbers and distribution across the Forest. This Environmental Assessment (EA) had been prepared to analyze and disclose the effects of a proposed integrated vegetation management program to eradicate and control invasive plants on the Forest. It provides general programmatic direction for weed and invasive species control. The guidance and analyses contained herein will be used to guide the development of annual operating plans throughout the Forest where invasive exotic plant management activities are proposed. Invasive exotic plants include noxious weeds (eg. yellow star thistle), but also include numerous other plant species that cause detrimental changes to native ecosystems. In this analysis, the term “noxious weed” is used to refer to those species that are designated as such on a state or federal list. The terms “invasive exotic”, “invasive plant” or “weed” are used to refer to the broader category of invasive plant species included in the analysis.

Purpose and Need for Action

The spread of invasive species threatens the health of native ecosystems by causing changes in the composition and functioning of native plant communities that are the foundation for native ecosystems. Invasive plants have characteristics that permit them to rapidly invade and dominate new areas, out competing other vegetation for light, moisture and nutrients. Some of these characteristics include (Westbrooks 1998):

- Early maturation;
- Profuse reproduction by seeds and/or vegetative structures;
- Seed with long viability periods;
- Seed dormancy allowing periodic germination during favorable conditions;
- Adapted to spread via human and natural agents such as in contaminated gravel or crop seed, in tires, and on livestock, pets or clothing;
- Production of biological toxins that suppress the growth of other plants;
- Prickles, spines or thorns that can cause physical injury and repel animals;
- The ability to parasitize other plants;
- Seeds that are the same size and shape as crop seed, making cleaning difficult;
- Root structures with large food reserves;
- Able to survive and produce seed under adverse environmental conditions;
- High photosynthetic rates.

Invasive plants are often spread by human activities associated with vehicles and roads, agricultural practices, urban development, contaminated livestock feed, contaminated seed, and poor range management practices (Belsky and Gelbard 2000). Monocultures of noxious weeds such as yellow star thistle can become established in unmanaged lands and spread to adjacent rangeland, forests, and farmlands, causing great environmental and economic impacts. According to a recent survey by the U.S. Department of the Interior, noxious weeds have invaded over 17 million acres of public lands in the West, more than quadrupling their range from 1985-1995 (Westbrooks 1998). When invasive species such as cheatgrass, red brome and medusahead are included, there are 100 million acres of moderately to heavily infested land. Invasive species are expanding their range on public lands at the rate of approximately seven square miles per day (Westbrooks 1998). The public has become increasingly concerned as aggressive noxious weeds replace native plants, reduce access to recreational sites, and reduce forage for livestock and wildlife.

Noxious weeds and invasive species may have adverse health effects on humans by causing mechanical injuries and creating allergic reactions. A summary of adverse environmental impacts of invasive exotic species on public lands is presented below (Westbrooks 1998).

Wildlife, Plant Communities and Biodiversity: Solid stands of invasive plants can replace natural ecosystems and lead to extinction of native plant species, including threatened and endangered species. Invasive plants can impair soil and water resources, ruin fish spawning habitat by causing soil erosion, reduce the amount of cryptogamic ground crust which is important for nitrogen fixation and degrade wildlife habitat by simplifying plant communities and reducing available forage.

Cultural Resources: Plant species and populations traditionally used for religious and cultural practices by American Indians, Hispanics, Anglos, and others can be threatened by invasive plant species.

Recreation: Invasive plants can be a nuisance to hikers, campers, boaters, pets and rafters, and can reduce revenues from hunting, fishing, and tourism.

Forests: Invasive plants can increase the risk of fire hazards, are serious problems in forest nurseries and can reduce regeneration, growth and yield in plantations.

Wetlands and Waterways: Invasive aquatic plants slow water flow which results in more evaporation from ditches, reduce water intended for crops and can interfere with boat travel.

Rights-of Way: Highway and Utility Corridors: Invasive weeds increase road maintenance costs by growing through cracks in asphalt, obscure vision at intersections and increase costs of vegetation management.

Rangeland and Pastures: Invasive plants can injure grazing animals and reduce forage and water available and can create or contribute to existing soil erosion problems.

The current cost to the U.S. economy is estimated at over $40 billion every year. This economic impact will increase without intervention (Griffith 1999). Invasive exotic plants do not require human disturbance to become established, and therefore pose an increasing threat to the integrity of wildland ecosystems (Olson 1999). These species are all introduced from other areas and have few natural, ecological controls to limit their spread. The increasingly devastating effects of weed invasion include reducing biological diversity, impacting threatened and endangered species and wildlife habitat, modifying vegetative seral stages, changing fire and nutrient cycles, and degrading soil structure (Olson 1999).

Existing Condition

While the Coronado National Forest does not have a severe problem with noxious weeds, there are small infestations of invasive exotic species in 7 of the 12 designated Ecosystem Management Areas (EMAs) that make up the Forest. The invasive exotic plant species included for analysis in this environmental assessment are those known to occur, suspected of occurring, or having the potential to occur on the Coronado National Forest. Species initially included for management consideration are listed in Table 1. Additional species that will be considered are any that are listed as a noxious weed in Arizona or New Mexico State regulations, identified as an invasive exotic species by the

Southwestern Region of the Forest Service, or are identified as a species of local concern to the Coronado National Forest.

Table 1. Species initially included in the management program

Species Common Name	Scientific Name	Status
Yellow starthistle Malta starthistle	*Centaurea soltitialis,* *Centaurea melitensis*	AZ & NM noxious weed NM noxious weed
Canada thistle	*Cirsium arvense*	AZ & NM noxious weed
Texas blueweed	*Helianthus ciliaris*	AZ noxious weed
Sweet resin bush	*Euryops subcarnosus*	AZ noxious weed
Salt cedar	*Tamarix spp.*	Regional list
Bull thistle	*Cirsium vulgare*	Regional list
Tree of Heaven	*Ailanthis altissima*	Local concern
Pentzia	*Pentzia incana*	Local concern
Buffelgrass	*Pennisetum ciliaris*	Local concern
Fountain grass	*Pennisetum setaceum*	Local concern
Giant reed	*Arundo donax*	Local concern
Johnsongrass	*Sorghum halepense*	Local concern
Lehmann lovegrass	*Eragrostis lehmanniana*	Local concern
African sumac	*Rhus lancea*	Local concern

One invasive exotic, Lehmann lovegrass, occurs in all EMAs, often in extensive populations. Other than Lehmann lovegrass, no invasive exotic plants have been noted in the Galiuro, Dragoon, Whetstone, Winchester, or Santa Teresa EMAs. Many of the known locations were identified during a 1999 survey of primary roads, recreation areas, and administrative sites on the Douglas, Nogales, Sierra Vista, and Safford Ranger Districts (Doc. 6, project record). The initial survey for the Santa Catalina EMA is not complete, although several species invasive plants have been identified in this EMA. In addition to the survey information, there are other known populations. Occurrence of each species is shown for each EMA in Table 2 and the locations of known populations are shown on maps 2-8. Additional surveys are needed in all EMAs. All known populations occur at the lower elevations, with the exception of the populations of Canada thistle, which have been found in the Pinaleno EMA at elevations over 8500 feet. Eight designated wilderness areas occur on the Forest. Only the Pusch Ridge Wilderness in the Santa Catalina Mountains is affected by infestations of invasive plants to any significant degree. Buffelgrass and fountain grass are spreading throughout canyons at lower elevations.

Limited invasive plant management efforts have been undertaken on the Forest to date. These efforts have been generally confined to control activities. Mechanical treatment, including burning, has been used to manage some populations, but it does not appear to effectively control the overall expansion of weeds or prevent the introduction of new weed species. In general, treatment with mechanical methods has been proven to be labor intensive and expensive, even with small weed populations. Soil disturbance associated with mechanical weed control efforts has proven to increase seed germination of target weed species. There is a need for an integrated, environmentally safe and cost effective program to control existing populations of weeds and to prevent or reduce the potential for future infestation on the Forest. Once weed populations become large, they can only be contained through constant, long-term intervention. Complete eradication once a species is well established is extremely difficult or impossible. Prevention of spread of weeds is the most cost effective and environmentally sound control method available.

Table 2. Presence of species by EMA

Species	Chiricahua EMA	Peloncillo EMA	Pinaleño EMA	Huachuca EMA	Santa Rita EMA	Tumacacori EMA	Santa Catalina EMA
Tree of Heaven	X			X	X	X	
Bull thistle	X						
Texas blueweed		X					
Yellow or Malta starthistle		Potential					
Sweet resin bush			X				X
Pentzia			X				X
Canada thistle			X				
Buffelgrass					X		X
Fountain grass					X		X
Giant reed				X			X
Salt cedar	X	X	X	X	X	X	X
Johnson grass				X			
Lehmann lovegrass	X	X	X	X	X	X	X
African Sumac							X

Tree of Heaven: This species is native to central China. It was first introduced into the United States at Philadelphia, PA in1784. It was introduced into California in the mid-1880s by Chinese immigrants, who valued the plant for its purported medicinal and cultural properties. It is now widely naturalized throughout the US. Tree of heaven occurs often on private land adjacent to the Forest, and there are small populations ranging from individual trees to small thickets on Forest lands in the Huachuca and Tumacacori EMAs. On the Forest, it is frequently found around abandoned mining settlements. Tree of heaven grows rapidly and is a prolific seed producer. Vegetative reproduction is by sprouting from stumps or root portions. It also appears to be somewhat allelopathic, that is, it produces a toxin that prevents the establishment of other plant species. Because of these characteristics, it can quickly take over a site and form an impenetrable thicket.

Bull thistle: There are approximately 40 acres in Chiricahua EMA infested with bull thistle. This area has been treated in the past with hand pulling and grubbing with limited success. It is a high priority for treatment.

Texas blueweed: The only population of Texas blueweed found is in the Peloncillo EMA. It is on private land but is adjacent to the Forest and poses a threat of infestation.

Yellow and Malta starthistle: There is an unconfirmed population of either Malta or yellow starthistle in the Peloncillo EMA on the Robertson allotment. There are populations on private land or lands of other jurisdiction adjacent to the Forest boundary. Both species are winter annuals that are members of the sunflower family (Asteraceae) and native to Europe. A single yellow starthistle plant can produce up to 150,000 seeds and the species has become a significant pest in some areas of the West. It currently infests millions of acres in Oregon, Idaho, Washington and California. As the plant invades sites, it displaces native species, reduces plant diversity and contributes to accelerated soil erosion and surface runoff. Because of its highly invasive tendencies, yellow star thistle is a high priority to survey the National Forest and treat any plants that may be found.

Sweet resin bush and Pentzia: There are two populations of sweet resin bush in the Pinaleño EMA that cover approximately 100 acres. Much more extensive infestations occur on State land adjacent to the Forest on Frye Mesa. Additional, smaller populations are found in the Santa Catalina EMA in Sabino Canyon and Molino Basin. There is one population of Pentzia in the Pinaleño EMA as well as a mixed population of the two species in the Marijilda Creek area. These have been treated in the past using prescribed fire and hand-grubbing. A Weed Management Area has been established, of which the Coronado National Forest is a member. The Natural Resource Conservation Service (NRCS) is leading eradication efforts in the Safford area adjacent to the Forest boundary.

Sweet resin bush and Pentzia were introduced for erosion control and livestock forage during a period that began in 1935 (Pierson and McAuliffe 1995). These non-native plants were provided to Civilian Conservation Corps (CCC) work crews by the Soil Conservation Service (SCS) for use in erosion control projects and as landscaping for facilities on Forest Service land. The full extent of the infestation resulting from CCC projects is unknown, but there were as many as ten CCC camps and additional temporary spike camps on Coronado National Forest lands. CCC crews completed many erosion control and revegetation projects in the 1930s, and projects were located in most of the EMAs. Those completed after 1935 are likely to have resulted in the introduction of the sweet resin bush and pentzia, and possibly other species as well.

Canada thistle: There are small populations of Canada thistle at the Snowflat Campground, Hospital Flat, and Columbine Work Center in the Pinaleño EMA. These populations have been treated by grubbing with limited success, and are a high priority for further treatment.

Buffelgrass: This grass occurs in most canyons on the front range of the Santa Catalina EMA as well as in the Santa Rita EMA. It causes an unnatural buildup of fine fuel in the Sonoran desert ecosystem (Van Devender and Dimmitt 2000). The three populations in the Santa Rita EMA are fairly isolated and are a high priority for treatment.

Fountain grass: Fountain grass occurs along the Mt. Lemmon highway up to about 5,500 feet in elevation, in Sabino Canyon, and many other canyons on the front range of the Santa Catalina EMA. It is widely used as an ornamental grass and is spreading rapidly in the desert. There is also an isolated population in the Santa Rita EMA, which is a high priority for treatment.

Giant reed: This species occurs in the Van Horn exclosure in the Huachuca EMA and in Sabino and Bear Canyons on the front range of the Santa Catalina EMA. The Van Horn population is small and dense in the exclosure. The Sabino and Bear Canyon populations are more extensive but are currently restricted to the Canyon from the Forest boundary to Sabino Dam.

Salt cedar: There are scattered individuals of this species across the Forest. There are known populations in Robles Canyon and Bear Canyon (Santa Catalina EMA) and Stockton Pass Wash (Pinaleño EMA).

Johnson grass: Johnson grass occurs along most highways in southern Arizona. As such, it is a species that will easily spread to the Forest. There are several plants of

Johnson grass in the Falls exclosure in Redrock Canyon (Huachuca EMA). This exclosure protects an endangered native fish so the infestation of Johnson grass is a high priority for treatment.

Lehmann lovegrass: This species occurs throughout the Forest. In the past, Lehmann lovegrass was seeded in many areas to prevent erosion (Cox et. al. 1984). The grass has extended in range far beyond the seeded areas (Cox and Ruyle 1986). Well-established populations are not a high priority for treatment, but new or small populations should be treated.

African sumac: This exotic tree has been identified in Pontatoc Canyon in the Santa Catalina EMA; however, the species is spreading rapidly in the foothills adjacent to the Forest near Tucson. The species is widely used in the Sonoran desert as an ornamental tree.

This list does not include all of the species on the noxious weed lists for Arizona and New Mexico (Doc. 17), nor does it include all species that Forest users may consider a problem. It is the best information available on the species posing the most immediate threat to the Coronado National Forest. Species occurring in other areas adjacent to or near the Forest can also pose a threat. Russian knapweed, spotted knapweed, and dalmation toadflax are some that could easily infest the Forest from existing populations in southern Arizona and New Mexico. Additionally, roadways connecting the United States and Mexico create a situation of high risk for transport of invasive exotic plants.

There is no coordinated noxious weed management plan for the Forest at this time. This EA will describe how the Forest proposes to control populations of exotic invasive plants that exist on the Forest or populations that may be introduced in the future. This EA will provide the analysis needed to evaluate and disclose the environmental effects of invasive plant management on the Forest.

Desired Condition

The following narrative was developed to describe the desired condition for the Forest at the end of 10-year term of the program:

Existing infestations of invasive exotic plants are eradicated or controlled through a coordinated Forest-wide approach to Integrated Vegetation Management. New populations are detected and treated as they become established. A Forest-wide approach is effective in controlling the spread of noxious weeds and invasive exotic plants, and is coordinated with the plans of other county, state and federal agencies. Treatment plans take into account the latest guidance regarding the protection of public health and ecosystem health well as the protection and recovery of federally-listed wildlife and plant species.

Proposed Action

To meet the purpose and need, the Coronado National Forest proposes to implement an Integrated Vegetation Management (IVM) approach to the control of invasive exotic plant species on the Forest. The purpose of the proposed action is to protect native plant communities on the Forest by preventing the introduction of invasive exotic plant species, eradicating invasive plant species where possible and by controlling the spread of established invasive plant species when eradication is not practicable. This action is needed because of the occurrence of invasive exotic plants on and adjacent to the Forest, and to meet the requirements of law, regulations and policy.

Integrated Vegetation Management is a decision-making and management process that uses a combination of expertise, treatment methods, monitoring, evaluation and education to achieve the following vegetation management goals (FSM 2080.2):

- Prevention of the introduction and establishment of invasive plant infestations.
- Containment and suppression of existing invasive plant and noxious weed infestations.
- Formal and informal cooperation with State agencies, landowners, weed control districts and boards and other Federal agencies in the management and control of invasive species.
- Education and awareness of employees, users of the Forest, adjacent landowners and State agencies about weed threats to native ecosystems.

The project area includes National Forest System lands in parts of Pinal, Pima, Santa Cruz, Cochise, and Graham Counties in southeastern Arizona and Hidalgo County in southwestern New Mexico on the Douglas, Nogales, Sierra Vista, Safford, and Santa Catalina Ranger Districts.

The proposed IVM approach would be divided into the four elements described below.

1. Treatment of existing populations

Implement an integrated vegetation management strategy using cultural, mechanical, biological, or chemical methods of control.

- **Cultural control methods** involve reducing disturbance, planting, fertilizing or generally encouraging desired native vegetation to limit the encroachment of invasive species.
- **Manual control methods** involve hand pulling, hand grubbing, clipping and burning.
- **Mechanical control** methods involve mowing, tilling and other mechanized means of removing plants.
- **Biological control methods** involve the release of insects or plant pathogens that impact invasive species by reducing the ability of the invasive plant to dominate native plant communities.
- **Chemical control methods** involve treatment with herbicides that selectively kill invasive species while maintaining desired native vegetation. There will be no aerial application of herbicides.

Depending on the extent of the infestation and the feasibility of treatment, weed populations will be proposed for eradication, or containment and control. Tables 3 and 4 show the specific treatment proposals for those populations to be eradicated and for those to be controlled or contained. Known populations to be treated are identified on the attached maps 2 - 8.

Where chemical treatment is considered warranted, the following herbicides are proposed for use: 2,4-D, Chlorsulfuron, Clopyralid, Dicamba, Glyphosate, Imazapic, Imazapyr, Metsufuron, Picloram., Sulfometron methyl (Sufometuron), Triclopyr, Tebuthiuron. Descriptions of each of these herbicides can be found in Appendix A.

Application of herbicides would be limited to spot treatment of individual plants or ground-based broadcast application on stands of weeds. Aerial application of herbicides is not being considered as an option for the IVM program.

The Regional Forester must approve all proposed herbicide uses on National Forest System lands. The Regional Forester may delegate this approval authority to other line officers on a case-by-case basis or by supplement to the Forest Service Manual (FSM 2151.04). Approval authority has not been delegated at this time (Doc. 74). Approval will be indicated by signing the Pesticide Use Proposal (PUP, Form FS-2100-2) as described under the Proposed Action (pp. 19-21, this EA). The approval of the use of herbicides in Wilderness Areas, Wilderness Study Areas or Research Natural Areas cannot be delegated. Any application of herbicides in these areas would require the approval of the Regional Forester on a case-by-case basis (FSH 2109.14 – Pesticide Use Management and Coordination Handbook).

2. Monitoring

The effectiveness of control methods will be monitored annually for a minimum of 5 years following treatment. Additional treatments will occur as necessary. All known populations of invasive plants will be monitored at least every 3 years noting density and area of infestation. Weed inventories on the Forest will be continued in order to detect new populations of invasive plants before they become well established and widespread.

3. Restoration

In areas where there are large concentrations of an invasive species, the area would be restored to native vegetation, if feasible, following treatment. Restoration efforts would mainly involve erosion control and the planting of native species. In those situations where conditions of the site, soils, competing vegetation or other factors make it unlikely that native species can be re-established in a timely manner, appropriate non-native, non-persistent species may be used for soil protection until native species can re-establish.

4. Prevention, coordination, cooperation and education

Continue to follow noxious weed prevention practices and incorporate guidance put forth in The Guide to Noxious Weed Prevention Practices (Appendix C) in planning for any resource management activities.

Continue on-going cooperation efforts with other agencies and landowners, and encourage new cooperative efforts as appropriate, especially the establishment of Cooperative Weed Management Areas. Opportunities exist to partner effectively with groups such as the Pima Invasive Species Council, other private organizations and public agencies to enhance invasive species control across landscapes with a mixture of public and private ownership. These efforts should include lands of all ownerships and jurisdictions to ensure overall control.

Partner with the State of Arizona and the State of New Mexico Departments of Transportation to cooperate on control of invasive exotic species and ensure mulches and seed mixes are weed free, including coordination of this treatment plan with the on-going Region-wide plan for treatment of invasive exotic plants in highway rights-of-way.

Continue to develop and implement educational and public awareness materials.

Timely, site specific review of treatment areas will occur on the districts prior to control activities to ensure that impacts to rare plants, wildlife and cultural resources will not occur as a result of weed management activities. All herbicide application will be done in accordance with Environmental Protection Agency (EPA) label restrictions. If monitoring determines that treatment activities are ineffective and control beyond the scope of this analysis becomes necessary, further analysis under NEPA would be conducted.

Other actions may be taken to assure an integrated approach to control of invasive exotic plants. These will be analyzed in the context of the planned revision of the Forest Plan beginning in Fiscal Year 2004 and may include, but not be limited to the following:

- Expand the current policy regarding weed-free livestock feed in Wilderness Areas to the entire Forest.
- Require use of weed-free mulches and seed mixes Forest-wide. Use native plant species for all re-vegetation and stabilization work. If native species do not meet the objectives of the project, non-native species may be used but must be sterile seed stocks or non-invasive species.

Consistency with Forest Plan Goals and Objectives

This action responds to the following goals and objectives outlined in the Coronado National Forest Land and Resource Management Plan (LRMP, pages 9-11).

- Maintain or enhance the visual resource through sound landscape management principles.
- Increase the public's awareness of their obligation to the resource and their responsibility in caring for it.
- Establish a dialogue with the public to gain their understanding of our goals and objectives and insure their informed participation in our management decisions.
- Develop Information Service Programs that will educate, inform, and involve people of southern Arizona and southwest New Mexico in management and enjoyment of the forest.
- Provide habitat for wildlife populations consistent with the goals outlined in the Arizona and New Mexico Department of Game and Fish Comprehensive Plans and consistent with other resource values.
- Provide for ecosystem diversity by at least maintaining viable populations of native and desirable nonnative wildlife, fish and plant species through improved habitat management.
- Improve the habitat of and the protection for local populations of Threatened and Endangered Species to meet the goals of the Endangered Species Act of 1973.
- To restore rangeland to at least a moderately high ecological condition (70% to 75% of potential production, fair range condition) with stable soil and a static or upward trend.
- Provide a favorable water flow in quantity and quality for off-Forest users by improving or maintaining all watersheds to a satisfactory or higher level.

In addition, the following Forest-wide standards and guidelines and Management Area direction will be met:

- "Coordinate, where needed, animal damage and plant control on Forest Service administered lands with the US Fish and Wildlife Service and State wildlife and plant agencies (LRMP, page 31-1)."
- "Safeguard water, people, animals, pets and property in connection with use of pesticides and fire retardants…(LRMP, page 45)."
- Conform to Department of Agriculture standards in the use of all pesticides and promote development of acceptable alternatives for the use of pesticides (LRMP, page 45)."
- "Chemicals may be used within guidelines approved by other agencies for the following purposes…Herbicides to control invading plants that reduce herbaceous forage. Not all of the control would be done by use of herbicides. Depending on individual site circumstances, the control might be by mechanical means, prescribed fire, fuelwood harvest, herbicides, or some combination (LRMP, pages 45-46)."
- "Maintain horizontal and vertical plant diversity…(LRMP, pages 48, 51, 63)."

Consistency with Laws and Policies

Noxious weeds and other invasive plant species have raised concerns about ecosystem health and economic impacts. These concerns have been translated into laws and policies relative to the management of our National Forests and Grasslands. The Federal Noxious Weed Act became law in 1974 and was updated in 1990 with the passage of the Food, Agriculture Conservation and Trade Act, commonly called the Farm Bill. The Farm Bill directed Federal agencies to coordinate with state and local governments to contain and control undesirable plant species by entering into Memorandums of Understanding and other agreements where appropriate. The Farm Bill also directed Federal agencies to develop policy direction, and Forest Service Manual 2080 was issued in November of 1995. In 1998, the Forest Service issued a National Strategy for weed management entitled "Stemming the Invasive Tide: Forest Service Strategy for Noxious and Nonnative Invasive Plant Management" (USDA Forest Service 1998). The President signed Executive Order 13112, addressing invasive species, in February 1999. This order directs federal agencies to prevent introduction and spread of invasive species, to cooperate with a newly created Invasive Species Council, and to produce and follow direction given in an Invasive Species Management Plan.

The Forest Service is also directed by Section 302(b) of the Federal Land Policy and Management Act of 1976 to "take any action necessary to prevent unnecessary or undue degradation of the [public] lands: (43 U.S.C. 1732). Supplementing this mandate is Section 2(b)(2) of the Public Rangelands Improvement Act of 1978 in which Congress reaffirms a national policy and commitment to "manage, maintain, and improve the condition of public rangelands" (43 U.S.C 1711). The regulations for implementing the National Forest Management Act of 1976 (36 CFR Part 219.27 a.3.) also provide direction for controlling noxious weeds.

The Federal Plant Protection Act and implementing regulations and policies, requires the Forest Service to cooperate with State, county, and other Federal agencies in the application and enforcement of all laws and regulations relating to management and control of noxious weeds. Forest Service policy in FSM 22.59.033 states: "Forest officers should place noxious weed management emphasis on those areas where cooperative efforts are underway, such as organized weed control districts. Within budgetary constraints, the Forest Service shall control, to the extent practical, noxious farm weeds on all National Forest System lands".

The Wilderness Act (P.L. 88-577) mandates that wilderness be managed so its community of life is untrammeled by man, its primeval character is retained and its natural conditions are preserved. Forest Service policy direction is to maintain wilderness in such a manner that ecosystems are unaffected by human manipulation and influences so that plants and animals develop and respond to natural forces (FSM 2320.2). The Wilderness Act and its implementing regulations (36 CFR 293) do not preclude the use of herbicides in wilderness to maintain the natural ecosystem, and the Manual appears to anticipate such use by establishing approval standards at 2323.04c. In order to preserve natural conditions and processes in wilderness, it may become necessary to remove invasive exotic vegetation. Herbicides are a potential tool for controling invasive species and may represent the appropriate "minimum tool" for accomplishing this objective.

The proposed action is responsive to these laws and policies. Lack of action against invasive plant species is clearly a violation of these laws and policies.

Adaptive Management Strategy

The proposed invasive plant management program provides direction for noxious weed management activities on the Forest for the next 10 years using an adaptive management approach. Adaptive management is a strategy that allows decision makers to take advantage of new information as it becomes available after a decision has been made. In other words, during the life of this project, invasive plants are likely to be introduced to new locations by vehicles, heavy equipment, livestock, wildlife, recreationists and all the usual vectors of spread, and will be detected through monitoring. It is also likely that additional species of invasive plants not identified in Table 1 may be discovered on the Forest over the term of the project. The Forest would respond to these new infestations by completing a site specific review to determine impacts to proposed, threatened, endangered and sensitive plants, wildlife and fish, as well as heritage resources or plant species of significance to local tribes. New populations will be treated as they are found as long as the conditions of this analysis and decision are met. Likewise, if implementation monitoring demonstrates that herbicides being used are not effective, and a new or improved product is available, the new product could be considered for use. An analysis would be accomplished to determine whether the effects of new treatments are similar to effects disclosed herein. As long as the new treatment activity fits within the range of effects analyzed and disclosed in the original EA, no further NEPA analysis will be performed. If monitoring determines that control beyond the scope of this analysis becomes necessary, further analysis under NEPA would be conducted.

Decision Framework

Given the purpose and need, the Forest Supervisor of the Coronado National Forest will review the proposed action and the other alternatives in order to make the following decisions:

- Whether the proposed action would result in significant environmental effects that would require the preparation of an Environmental Impact Statement, or if there is a finding of no significant impact.
- If significant impacts are not anticipated, the Forest Supervisor will determine whether the proposed action will proceed as described above and in Chapter 2, as modified by an alternative, or not at all.
- If it proceeds, the Forest Supervisor will determine the mitigation measures and monitoring requirements to be implemented by the Forest Service, and whether the project requires a Forest Plan amendment.

Public Involvement

The proposal was first provided to the public and other agencies for comment in a Scoping Report on March 23, 2000 (Doc. 13). Comments from this original scoping are being retained and included in the current analysis (Docs. 11-16). A revised public scoping notice was sent to 330 individuals and organizations on July 5, 2002 (Doc. 46). The proposal was posted on the Coronado National Forest internet site from July 2002 to May 2003. Approximately 18 comments were received (Docs. 48-65). Members of the interdisciplinary team attended a meeting of the Pima Invasive Species on August 13th, 2002. In addition, the agency has participated in the Euryops and Pentzia Weed Management Group since 1999 (Docs 3, 4 and 7).

In accordance with regulations at 36 CFR 215, a 30-day comment period was initiated on November 24, 2003 with the publication of a legal notice in the Arizona Daily Star and Tucson Citizen. The comment period ended on December 24, 2003. In addition to the legal notice, a detailed description of the proposed action was also sent to 55 individuals and groups and posted on the Forest's web site. One response was received and the comments have been considered in developing the analysis (Doc. 73).

Issues

Using the comments from the public, tribes, organizations and other agencies, the interdisciplinary team developed a list of issues to address. The Forest Service separated the issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations require this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" A list of non-significant issues and reasons regarding their categorization as non-significant may be found at Doc. 65 in the project record.

As for significant issues, the Forest Service identified the following issues during scoping:

Issue 1: Effects of the alternatives on non-target native vegetation, including threatened, endangered and sensitive species. Effects will be described in narrative and tabular form through a wildlife specialist's report, biological assessment and evaluation and analysis of effects on management indicator species (MIS) and other wildlife, fish and plants. Mitigation measures have been included in the design of all action alternatives to minimize exposure to non-target species.

Issue 2: Effects of the alternatives on non-target terrestrial and aquatic wildlife, including threatened, endangered and sensitive species. Wildlife exposure risks have been evaluated in a number of risk assessments, including the Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4 and 10 and on the Bonneville Power Administration Sites (USFS 1992), which is incorporated herein by reference. Effects will be described in narrative and tabular form through a wildlife specialist's report, biological assessment and evaluation and analysis of effects on management indicator species (MIS) and other wildlife, fish and plants. Mitigation measures have been included in the design of all action alternatives to minimize exposure to non-target species.

Issue 3: Effect of the alternatives on human health (public and workers). Human exposure risks have been evaluated in a number of risk assessments, including the Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4 and 10 and on the Bonneville Power Administration Sites (USFS 1992), which is incorporated herein by reference. The evaluation criteria for these effects are the risks to human health of herbicide use, the predicted location and size of area to be treated, preferred treatment method, and identification of areas where no chemical treatments would be used. Two alternatives (No Action and No Herbicides) are responsive to this issue.

Issue 4: Effects of the alternatives on soil and water quality and quantity. Evaluation criteria used to analyze these effects are tabular and narrative specialists reports on water quality, soil quality, upland vegetation and riparian area condition. Protections for surface and ground water quality are included in the action alternatives through prescribed mitigation measures and label restrictions for herbicide use.

Issue 5: Costs vs. benefits. The proposed action includes activities that will be subsidized by taxpayers. Evaluation criteria for this issue will be the relative costs of treatments for each alternative.

Issue 6. List of invasive species identified for treatment. Some respondents suggested additions to the list of species proposed for treatments, notably African sumac and red brome. Others pointed out that species such as Bufflegrass and Lehmann lovegrass have value for soil stabilization and should not be considered for control.

Issue 7. Vegetation treatments in wilderness. Some respondents suggested that by excluding the use of herbicides in wilderness areas the Forest would significantly decrease its chances of success at controlling invasive species. One respondent questioned the compatibility and legality of herbicide use within wilderness in response to the 30-day opportunity to comment.

Issue 8. Use interactions and prevention. The proposed action does not adequately provide for prevention of the spread of invasive exotic plant populations. The evaluation criteria for this issue will be locations of invasive exotic plants in relation to permitted activities on the Forest, and a review of existing guidelines for noxious weed prevention.

Issues and Concerns Addressed Through Project Design.

In response to the scoping comments, the proposed action was modified to address some of the issues identified. African sumac (*Rhus lancea*) was added to the list of species to be controlled. Two respondents suggested that red brome (*Bromus madritensis* ssp. *rubens*) also be included. This aggressive, winter-spring growing exotic annual grass occurs at lower elevations on the Forest, but is not expected to spread into higher elevations. Effective control of existing populations would be difficult if not impossible and Forest efforts will focus on prevention of seed introduction through weed prevention practices described in Appendix C. No treatments are proposed, so the species is not listed in the tables of species identified for containment or eradication.

In response to comments that suggested that limiting herbicide treatments to non-wilderness areas would reduce the Forest's ability to effectively control some invasive species, the proposed action has been modified to include limited herbicide treatments within wilderness areas and research natural areas (RNAs). No treatments are proposed in wilderness at this time, but it was deemed appropriate to widen the scope of the analysis to consider this potential, should the need arise. This is particularly true in the Santa Catalina EMA where the 2003 Aspen fire burned approximately 85,000 acres, including a large portion of the Pusch Ridge Wilderness. Several invasive species are found in or adjacent to the wilderness and are predicted to invade into burned areas.

With regard to objections to the consideration of herbicide use in wilderness, see *Consistency With Laws and Policies* on pages 12 and 13 of the EA.

The proposed action responds to the comments raised relative to use interactions and prevention by adopting an integrated vegetation management approach that incorporates several measures to prevent the introduction and spread of invasive plants on the Forest.

Incorporation by Reference

Regulations implementing the National Environmental Policy Act (NEPA) provide for the reduction of bulk and redundancy (40 CFR 1502.21) through incorporation by reference when the effect will be to reduce the size of documents without impeding agency and public review of the action. The following document is incorporated by reference and forms the basis for the conclusions related to human health and effects to non-target species.

- Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4 and 10 and on Bonneville Power Administration Sites (USFS 1992).

To insure that the most recent information is reflected in this EA, updated risk assessments for the following herbicides are also incorporated by reference. Copies of the assessments for 2,4-D, Clopyralid, Dicamba, , Imazapic, Imazapyr, Metsulfuron

Methyl, Picloram, Sulfometron Methyl, Triclopyr, aquatic formulations of Glyphosate and surfactant effects on Glyphosate toxicity are available on the Forest Service web site at www.fs.fed.us/foresthealth/pesticide/risk.

CHAPTER 2 - ALTERNATIVES

This chapter describes and compares the alternatives considered for the Invasive Exotic Plant Management Program. It includes a description of each alternative considered. This section also presents the alternatives in comparative form, defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., use of herbicides versus the use of manual and cultural methods only) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the risk to humans and non-target species of using herbicides). Alternatives are also compared as to compliance with law, regulation and policy. Finally, this chapter describes mitigation measures developed to address significant issues.

Alternative 1 - No Action

Under the No Action alternative, current management plans would continue to guide management of the project area. A programmatic approach to Integrated Vegetation Management for controlling or eradicating invasive exotic plants and preventing new populations would not be taken. Individual populations of noxious weeds and invasive exotic plants may be treated by various methods, however each treatment would be authorized by a separate analysis. The No Action Alternative provides the baseline for comparison against all action alternatives. Under the No Action alternative, concerns for effects of herbicides on non-target species (Issues 1 and 2), effects of herbicides on human health (Issue 3), effects of treatments and re-vegetation on water quality (Issue 4), and the cost of action (part of Issue 5) are moot.

Alternative 2 – Non-herbicide control combined with a program of monitoring, restoration and prevention

This alternative includes all IVM methods except for herbicide application. All other elements of the action would be identical to Alternative 3, the proposed action. Mechanical and cultural control methods would be used to manage existing invasive plant populations and to control new populations as they occur. Mechanical methods would include top-cutting plants, digging, pulling or burning of infested sites. Cultural control methods would be used to encourage occupation of the Forest by desired vegetation in order to reduce the vulnerability of sites to invasion by weeds. Monitoring would occur to detect the presence and spread of invasive species. Education, prevention and cooperation would occur as described under the proposed action. This action was formulated to address concerns for effects of chemical herbicides on non-target species (Issue 1 and 2) and human health (Issue 3).

Alternative 3 - Integrated Vegetation Management - The Proposed Action

This alternative includes a complete integrated vegetation management approach to the management of invasive species on the Forest. Mechanical, cultural, biological and chemical control methods would be available for use and would be tailored to fit each specific situation. Monitoring, prevention, education and cooperation are incorporated into this alternative, as described in Chapter 1. The Forest would use all methods to eradicate or contain and control populations of invasive species as described in Tables 3 and 4. If the use of herbicides is considered warranted, herbicides will be applied in compliance with their EPA approved label directions and restrictions.

Table 3. Proposed *eradication* of existing populations

Species common name	Growth habit	Proposed treatment
Tree of Heaven	Tree with prolific root and stump sprouting; not shade tolerant; allelopathic to other trees	Small trees, oil basal with 25% Garlon 4 (triclopyr); large trees, cut-surface application with 50% Garlon 3A (Triclopyr). This will be 70-80% effective and follow-up treatments will be necessary. Other effective herbicides are glyphosate, dicamba, metsulfuron methyl and imazapyr.
Yellow starthistle	Winter annual herbaceous species; prolific seed productions; spreads rapidly	Hand pull plants if only a few; ensure most of root is removed. Remove and burn pulled plants to destroy seed. If area is too large for effective hand pulling, apply herbicides. Effective herbicides are picloram, dicamba, 2,4-D, clopyralid, and glyphosate. Ensure good stand of native species; revegetate if necessary.
Malta starthistle	Winter annual herbaceous species; prolific seed productions; spreads rapidly. Small seed head formed in the center of rosettes makes hand pulling ineffective.	Hand grub, removing all of the root. Remove and burn pulled plants to destroy seed. If area is too large for effective hand pulling, apply herbicides. Effective herbicides are picloram, dicamba, 2,4-D, clopyralid, and glyphosate. Ensure good stand of native species; revegetate if necessary.
Canada thistle	Aggressive perennial with creeping root system. Reproduces easily from roots.	Repeated annual treatments of applied herbicides. Effective herbicides are 2,4-D, chlorsulfuron, dicamba, clopyralid, metsulfuron, glyphosate, alone or in mixes. Hand pulling not effective because of root system.
Buffelgrass (small population in the Santa Rita EMA)	Perennial with moderate spread by seed and slow spread vegetatively.	Hand pull plants in Santa Rita EMA; if this is not successful, apply herbicide ; repeat pulling and/or herbicide use as necessary to prevent re-establishment. Effective herbicides are glyphosate, metsulfuron methyl and imazapic.
Fountain grass (small population in the Santa Rita EMA)	Perennial with slow spread by seed; generally does not spread vegetatively but there are non-seed producing cultivars.	Hand pull plants in Santa Rita EMA; if this is not successful, spot apply herbicide (glyphosate, metsulfuron methyl or imazapic); repeat pulling and/or herbicide use as necessary to prevent re-establishment.
Johnson grass (Redrock Canyon)	Perennial rhizomatous grass; spreads rapidly	Hand grub individuals in Redrock Canyon when ground is moist. Repeat as necessary to prevent re-establishment. Consider using herbicides (glyphosate labeled for wetland use) if grubbing causes too much soil disturbance, or if treatment is ineffective.

Species common name	Growth habit	Proposed treatment
Sweet resin bush	Low growing perennial shrub; reproduces by seed; expands slowly at first and then rapidly; replaces native vegetation.	Work with WMA to determine most effective treatment. Most likely will include burning, pulling, and ground-based broadcast application of herbicides (picloram or clopyralid).
Pentzia	Perennial shrub	Work with WMA to determine most effective treatment. Most likely will include burning, pulling, and herbicides (picloram and clopyralid).

Complete eradication of existing populations may be difficult to achieve, so only invasive plant populations that are small and localized or that present significant risks to ecosystem health have been identified for eradication. Many populations are already well-established, but their spread can be contained through management activities. These species/populations are displayed in Table 4.

Table 4. Proposed *containment* and *control* of existing populations

Species common name	Growth habit	Proposed treatment
Bull thistle	Biennial thistle; establishes taproot but not creeping roots; prolific seed producer in open areas.	Apply herbicides on existing population followed by maintaining light to moderate grazing to ensure good cover by native species. Apply when plants are in rosette stage. Revegetate if necessary.
Buffelgrass	Perennial with moderate spread by seed and slow spread vegetatively.	Monitor populations; treat new populations with hand pulling and/or herbicides (see previous section).
Fountain grass	Perennial with slow spread by seed; generally does not spread vegetatively but there are non-seed producing cultivars.	Monitor populations; treat new populations with hand pulling and/or apply herbicides (see previous section).
Giant reed	Large bamboo like grass. Prolific shoot production; spreads rapidly vegetatively.	Treat individual plants by cutting then treatment of cut surface with glyphosate labeled for wetland use. Treat post-flowering and pre-dormancy. Treat in Sabino and Bear Canyons when dry if possible. Remove dead material in Sabino and Bear Canyons after 2-3 weeks.
Salt cedar	Woody shrub; reproduces by seed	Small trees, oil basal with 25% Garlon 4; large trees, cut-surface application with 50% Garlon 3A. This will be 70-80% effective and follow-up treatments will be necessary.
Johnson grass	Perennial rhizomatous grass; sprouts readily	Monitor populations; treat new populations by hand pulling when ground is moist and/or apply herbicides.
Lehmann lovegrass	Perennial bunchgrass; highly adaptable and spreads rapidly	If found in small populations, hand pull or treat with herbicide (glyphosate, metsulfuron methyl or imazapic) and revegetate as needed.
African sumac		Hand pull small plants; cut down and spot treat with herbicides if too large to effectively pull.

Each year before weed management activities begin, an annual operating plan shall be prepared by the District proposing plant treatments. If herbicides are proposed, a

Pesticide Use Proposal (PUP), Form FS-2100-2 (Appendix B), must be completed according to Forest Service policy (FSM 2100), and this proposal may be used as the annual operating plan. This plan will include a list of each site to be treated, method to be used, herbicide and rate of application if applicable, map of the site and legal description, and area to be treated. This plan will be reviewed by the District or Forest TEPS plant coordinator, wildlife biologist and heritage resource specialist to ensure that effects of that treatment are within the scope of this analysis. Site-specific mitigation measures and/or additional surveys and clearances may be specified at this time, should concerns with any of these resources arise. If herbicides are proposed, the Forest pesticide coordinator (or Regional Pesticide Coordinator in the absence of a Forest coordinator) will review site-specific operating plan. The PUP with associated supporting documentation will be forwarded to the Regional Forester for approval.

During the course of the season, it is likely that new infestations will be found and require quick action to control. The annual operating plan will be updated at this time, and signed off by the previously mentioned specialists and the Forest pesticide coordinator before treatment. Reviews must be timely to allow management of new weed infestations to minimize seed production and potential spread, but are important to prevent unintended impacts. The annual operating plan will be available to the public on request.

Mitigation Measures Common to All Action Alternatives

- Invasive species populations would be treated only after the area has been evaluated and surveyed for sensitive plant species listed in Table 7 and/or identified by the District Biologist. Field surveys will be conducted within occupied and potential habitat for sensitive species. The scope of the survey will be dependant on the type of treatment proposed, but will be sufficient to provide for the identification and protection of sensitive species within the project area. Individuals and populations of sensitive plants will be flagged or otherwise identified so that they can be avoided during treatment. If necessary, a buffer zone of sufficient size will be established to protect sensitive species from mechanical disturbance or spray drift.
- Heritage resources will be identified and protected from any ground disturbing activities.
- Spray trucks, all terrain vehicles (ATVs), tractor-mounted mowers and other equipment used for invasive plant management will not be used in such a way that would increase erosion. Steep or highly erodible slopes will be avoided, and soil disturbance will be minimized.
- Desirable vegetation in riparian zones will be retained.
- Heavy equipment will not be used within 30 feet of any stream bank. Handheld or ATV-mounted equipment will be used within this zone.
- Prevention measures prescribed in Appendix D will be followed during agency activities to the degree possible to minimize invasive plant introduction and

spread on the Forest. This is the single most effective and least expensive weed management option available.

- Education efforts to increase awareness of the public and agency personnel will be implemented.
- The only biological control agents that would be considered for use would be those selective to only the target species, and approved by the Animal Plant Health Inspection Service (APHIS) for use on that species. There are currently no biological control agents being considered for use on the Forest.
- If restoration of treated areas included establishing new plants, this would be accomplished by broadcast seeding of native species or non-persistent, non-native cover crops.
- All sites treated for invasive species will be monitored and retreated as necessary. A monitoring plan will be prepared as part of each treatment activity. Baseline monitoring to determine existing conditions will occur prior to treatment. Implementation monitoring will occur during treatments to insure design and safety standards are followed and that specified buffers for sensitive species or live water have been correctly established and enforced.
- Effectiveness monitoring will be conducted to aid in planning subsequent treatments and to determine target plant response to treatment; native plant community response to treatment; and whether there are any unforeseen adverse impacts to resources from invasive plant control actions.

Mitigation Measures Involving the Use of Herbicides

The application of herbicides is tightly controlled by state and federal agencies. The Forest Service is required to follow all state and federal laws and regulations concerning the use of herbicides. The following measures and design features are common to all alternatives involving the use of herbicides:

- Herbicides will only be used after it has been determined that they offer the most practical, timely and economical method for control.
- All applicable state and federal laws, including herbicide label requirements will be followed.
- Projects will be supervised by a Forest Service certified applicator who will be responsible for insuring safe storage, handling, application and disposal of herbicides.
- Herbicides will be applied only by ground-based equipment, including hand painting or daubing, backpack sprayers and spray units on ATV’s or trucks. In areas with sensitive vegetation, spot application will be used to treat individual weeds while protecting desired vegetation. Spot application requires that the site be revisited many times to treat plants that were missed or have grown since the previous application, making this method less effective than broadcast treatments. Spot application is not a good choice for all sites and situations but is useful when few weeds and sensitive vegetation are present.

- Picloram will not be used where the water table is within 40 inches of the surface; where soil permeability would be conducive to water contamination.
- Only herbicides labeled for aquatic use (ie. Rodeo (glyphosate) Renovate (triclopyr) and Weedar 64 (2,4-D amine)) will be used within 30 feet of streams and other bodies of water.
- Persons involved in mixing, loading and applying herbicides will be required to wear appropriate personal protective equipment as required on the label.
- Areas used for mixing herbicides and cleaning equipment shall be located where spillage will not run into surface waters or result in ground water contamination.
- All requirements in a Safety and Spill Plan (Appendix D) will be followed.
- Regional Forester approval of the Pesticide Use Proposal (Form FS 2100-2) will be necessary for the application of any herbicide, unless this authority is delegated to the Forest Supervisor. Approval for the use of herbicides in Wilderness cannot be delegated.
- Treatment areas will be signed to alert the public of the herbicide application.
- Landowners within ½ mile of the area to be treated with herbicide will be notified in writing before the project is undertaken.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in Table 5 compares the alternatives in terms of project goals, regulations and policies. Information in Table 6 is displays levels of effects where different levels of effects can be distinguished quantitatively or qualitatively among alternatives.

Table 5. Comparison of Alternatives in Terms of Project Goals. Law, Regulation and Policy

Meets the purpose and need for action	
Alternative 1	No. Invasive exotic plant populations would not be effectively managed.
Alternative 2	In part. Would not authorize the use of herbicides, therefore would limit effectiveness of treatments.
Alternative 3	Yes. Authorizes the most effective treatments Forest-wide, including Wilderness areas.
Consistent with Forest Plan	
Alternative 1	No. Allows for uncontrolled spread of invasive exotic plants
Alternative 2	Yes. However, reliance on cultural and manual methods would result in result in a higher level of short-term degradation of visual resource, rangeland condition, wildlife habitat, and water quality when compared with alternatives 1 and 3.
Alternative 3	Yes. Maintains or enhances the visual resource, increases the public's awareness through dialog and education, provides habitat for wildlife including TES, maintains or enhances rangeland condition, provides a favorable water flow in quantity and quality by improving or maintaining all watersheds to a satisfactory or higher level.
Consistent with law, regulation and policy	
Alternative 1	No. Not responsive to the Farm Bill of 1990, Forest Service Manual

	2080, the 1998 Forest Service National Strategy (Stemming the Invasive Tide), or Executive Order 13112.
Alternative 2	No. Ineffective management results in dissatisfaction of cooperators and does not effectively prevent an increase in size of many invasive plant infestations (those that are not effectively treated by physical, cultural or biological methods). Not responsive to pertinent laws.
Alternative 3	Yes. Allows the agency to enter into cooperative weed management agreements, implement effective management strategies, and prevent the introduction and spread of invasive species as required in state and federal laws.

Table 6. Comparison of the Alternative in Terms of the Issues.

Issue 1: Effect of the alternatives on non-target vegetation.	
Alternative 1	Invasive species population would continue to expand and new populations would become established. Native plant communities would become less diverse and may be replaced entirely by monocultures of invader species. Changes in fine fuels potentially increase fire frequency, favoring the spread of exotic grasses. No effects to native species from treatments. This alternative would result in the highest level of degradation of forage and habitat for native wildlife over the term of the analysis.
Alternative 2	Invasive species continue to spread, but not as fast as Alternative 1. Prevention measures proposed will slow the introduction of invasives, but manual control alone will likely be insufficient to control the spread of existing populations. Native plants in some areas may be replaced by monocultures of invader species. Fire frequency in some areas will increase and overall plant species diversity will decline. Manual control would result in short-term displacement of wildlife
Alternative 3	Localized populations of invasive species will be eliminated, reducing the risk for further spread. Prevention practices will minimize the introduction of new populations. Minor effects to non-target vegetation will be minimized by project design and mitigated by overall increases in plant diversity as invasives are reduced. No effects to TEPS plants. The overall extent and occurrence of invasive plants will be reduced compared to Alternatives 1 and 2. Herbicide exposure risks to wildlife are minimal. Long-term restoration of native plant communities will increase habitat capability in infested sites.
Issue 2: Effect of the alternatives on wildlife.	
Alternative 1	Tap-rooted invasive species replace fibrous-rooted natives, increasing runoff and sediment yield. Expansion of buffelgrass results in decreases in surface flow, but increases the potential for wildfire and subsequent erosion. Expansion of salt cedar potentially reduces streamflows
Alternative 2	Effects to water as a result of weed expansion will be similar to Alternative 1, but weed expansion may be slower. Hand removal of invasives results in short-term soil disturbance and sediment yield into nearby streams. No effect to water quality as a result of herbicide use.
Alternative 3	This alternative results in the greatest restoration of native plant communities, reducing surface runoff and sediment yield. Effects to

	water quality as a result of herbicide use will be insignificant as a result of use restrictions and mitigation measures. Soil disturbance will occur as a result of hand removal of plants, but not to the degree anticipated under Alternative 2.
Issue 3: Effect of herbicide use on human health.	
Alternative 1	Little effect on human health. Slight increase in wildfire potential which may lead to indirect effects from smoke.
Alternative 2	Effects similar to Alternative 1. Additional slight risk for injury to personnel performing plant treatments.
Alternative 3	Effects similar to Alternative 1 and 2. Risks associated with exposure to herbicide will be insignificant to the public at large. Some minor risk of exposure to workers, but minimized by the use of personal protective equipment.
Issue 4: Effects of the alternatives on soil and water quality.	
Alternative 1	Increases in tap-rooted species increase surface runoff in some areas. Increased distribution of buffelgrass results in decreased runoff, but increases fire hazard and indirect effects from fire. No effects from herbicide use.
Alternative 2	Increases in tap-rooted species increase surface runoff in some areas. Increased distribution of buffelgrass results in decreased runoff, but increases fire hazard and indirect effects from fire. Spread of invasives will not be as rapid as under Alternative 1. Hand and mechanical treatment of weeds results in minor soil disturbance. No effects from herbicide use.
Alternative 3	Removal of invasive plans, combined with restoration will favor the establishment of native vegetation and more natural soil and water quality conditions. Use of herbicides will result in short-term presence of herbicides in soil. Mitigation measures will reduce the risk of water contamination.
Issue 5. Costs of treatment.	
Alternative 1	No additional costs compared to current conditions.
Alternative 2	Greatest cost per acre, least effective.
Alternative 3	Cost per acre less than Alternative 2, most effective.
Issue 6. List of Invasive species identified for treatment	
Alternative 1	Invasives would be identified and treated on a case-by-case basis, but a programmatic forest-wide approach would not be applied.
Alternative 2	This issue was resolved through changes in project design. Adaptive management provides for treatment of additional species as the need arises.
Alternative 3	This issue was resolved through changes in project design. Adaptive management provides for treatment of additional species as the need arises.
Issue 7. Vegetation Treatments in wilderness.	
Alternative 1	Wilderness treatments would not be precluded, but very likely would not occur.
Alternative 2	This issue was resolved through changes in the proposed action. Hand removal of weeds will control some new populations, but extensive populations may not be contained.

Alternative 3	This issue was resolved through changes in the proposed action. Hand removal of weeds will control some new populations. Control of infestations using herbicides may be proposed and carried out with approval of the Regional Forester (Pesticide Use Proposal; Form FS 2100-2).
Issue 8. Use interactions and prevention.	
Alternative 1	No programmatic approach to prevention would occur.
Alternative 2	Integrated Vegetation Management incorporates prevention practices intended to minimize the establishment of invasive species.
Alternative 3	Integrated Vegetation Management incorporates prevention practices intended to minimize the establishment of invasive species.

Alternatives Considered but Eliminated from Further Analysis

An original proposal to exclude the limited use of herbicides in wilderness areas was not considered in detail because it was determined that, given the nature and extent of existing weed infestations and the potential for spread into the Pusch Ridge Wilderness, hand methods alone may be insufficient to control populations of weeds before significant spread. The Regional Forester must approve all herbicide use in Wilderness and Research Natural Areas; however, it is appropriate to analyze the effects of such a proposal in the context of the EA. If the use of herbicides in these areas were entirely precluded, it would not be possible to achieve the stated purpose and need for the proposed action.

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CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for the comparison of alternatives presented in the chart above.

Project Area

The Coronado National Forest contains approximately 1,724,271 acres in 12 distinct blocks of land (Ecosystem Management Areas, EMAs) scattered across southeastern Arizona and into Southwestern New Mexico. The Forest consists of several mountain ranges within the Basin and Range Geographic Province that form an archipelago of "sky islands" connecting the Rocky Mountains to the Sierra Madre Occidental in Mexico. It is located on the border between the Sonoran and Chihuahuan deserts. Elevations range from 2,800 to 10,720 feet.

Geology is complex and has resulted in a highly variable and complex soil pattern. Climate varies depending on elevation. At lower elevations, summer temperatures can exceed 110° and annual precipitation ranges from 11 to 13 inches per year. Higher elevations are cooler and wetter with annual precipitation approaching 30 inches per year and significant snow accumulations.

As a result of these factors, the Forest supports a wide variety of biotic communities and a diverse assemblage of wildlife and plant species. Vegetation communities on the forest include over 1,000 plant species. Major vegetation types include desert scrub, desert grassland, broadleaf evergreen woodland, coniferous woodland, transition coniferous forest, mixed conifer forest, dry desert riparian areas and deciduous riparian areas. Almost 580 vertebrate species are found on the Forest. Many of these species are endemic to the highlands of Mexico and are found nowhere else in the United States.

Specific resource environments will be described in the appropriate sections that follow. Only those resources that would be potentially affected by this proposal or by the spread of invasive species are included in the analysis.

The analysis area for this environmental assessment (EA) is the entire Coronado National Forest (Map 1). However, the actual area of invasive plant infestation, excluding Lehmann lovegrass, is estimated to be less than 2000 acres. With the exception of Lehmann lovegrass, weed infestations on the Forest are generally localized rather than widespread. Nevertheless, weed infestations are found in 7 of the 12 EMAs that comprise the Forest and in a variety of vegetation types. Weed infestations often occur in previously disturbed areas, riparian corridors, along roadways or adjacent to private lands.

Invasive exotic plant infestations are generally located in the low to mid-elevations.(see Maps 2-8). The size of infestations are variable, from individual plants to infestations over about 100 acres. In riparian areas, infestations currently are at a low level, and only a few hundred plants are known to occur.

Vegetation – Forest Plant Communities (Issue 1)

Affected Environment – Forest Plant Communities

Vegetation on the forest is diverse, ranging from desert scrub to subalpine forests. Major vegetation units are described below.

Southwestern Desertscrub lands are found at elevations less than 4,200 feet. Mean annual air temperature ranges from about 62° to 72° F. Mean annual precipitation ranges from about 8 to 11 inches. The dominant native vegetation is sahuaro (*Cereus giganteus*), palo verde (*Cercidium* spp.), creosotebush (*Larrea tridentata*), ocotillo (*Fouquieria splendens*), mesquite (*Prosopis juliflora*), catclaw (*Mimosa bifuncifera*), and brittle bush (*Encelia* spp.).

Desert Grasslands are found at elevations of about 3,200 to 6,200 feet. Mean annual air temperature ranges from about 59° to 70° F. Mean annual precipitation ranges from about 11 to 14 inches. The dominant native vegetation are grasses including, but not necessarily limited to, bush muhly (*Muhlenbergia porteri*), Texas bluestem (*Andropogon cirratus*), tobosa (*Hilaria mutica*), curlymesquite (*Hilaria belangeri*), black grama (*Bouteloua eripoda*), sideoats grama (*Bouteloua curtipendula*), and hairy grama (*Bouleloua hirsuta*). Incidental to major overstory amounts of mesquite (*Prosopis* spp.) also occur. The exotic Lehmans lovegrass (*Eragrostis lehmanniana*) also is common.

Plains Grasslands are found at elevations of about 4,200 to 7,200 feet. Mean annual air temperature ranges from about 56° to 64° F. Mean annual precipitation is about 20 inches. The dominant native vegetation are grasses including blue grama (*Bouteloua gracilis*), plains lovegrass (*Eragrostis intermedia*), and wolftail (*Lycurus setosus*).

Mountain Grassland/Meadows are found at elevations greater than 6,200 feet. Mean annual air temperature ranges from about 45° to 50° F. Mean annual precipitation is 25 inches or more. The dominant native vegetation are sedges (*Carex* spp.), fringed brome (*Bromus ciliatus*), wheat grasses (*Elymus* spp.), long tongue muhly (*Muhlenbergia longligula)*, deer grass (*Muhlenbergia rigens*), bullgrass (*Muhlenbergia emersleyi*), pine drop seed (*Blepharoneuron tricholepis*), and june grass (*Koeleria macrantha*).

Chaparral are found at elevations of about 4,200 to 7,200 feet. Mean annual air temperature ranges from about 52° to 58° F. Mean annual precipitation ranges from about 16 to 21 inches. The dominant native vegetation is mountain mahogany (*Cercocarpus* spp.), desert ceanothus (*Ceanothus greggii*), manzanita (*Arctostaphylos* spp.), toumey oak (*Quercus toumeyi*), emory oak (*Quercus emoryi*), silver leaf oak (*Quercus hypoleucoides*), Arizona white oak (*Quercus grisea*), and a scattering of Chihuahua pine (*Pinus leiophylla*), pinyon pine (*Pinus cembroides*), and ponderosa pine (*Pinus ponderosa*). Turbinella oak (*Quercus turbinella*) may also be present.

Broadleaf Evergreen Woodlands are found at elevations of about 4,200 to 7,200 feet. Mean annual air temperature ranges from about 52° to 58° F. Mean annual precipitation ranges from about 16 to 19 inches. The dominant native vegetation is emory oak

(*Quercus emoryi*), Arizona white oak (*Quercus grisea*), alligator juniper (*Juniperus deppeana*), manzanita (*Arctostaphylos* spp.), and *(Juniperus erythrocarpa)*.

Coniferous Woodlands are found at elevations of about 4,200 to 7,200 feet. Mean annual air temperature ranges from about 50° to 58° F. Mean annual precipitation ranges from about 17 to 22 inches. The dominant native vegetation is pinyon pine (*Pinus cembroides*), emory oak (*Quercus emoryi*), Arizona white oak (*Quercus grisea*), alligator juniper (*Juniperus deppeana*), and Chihuahua pine (*Pinus leiophylla*).

Deciduous Forests are found at elevations of greater than 6,200 feet. Mean annual air temperature ranges from about 44° to 50° F. Mean annual precipitation is 25 inches or more. The dominant native vegetation is aspen (*Populus tremuloides*), Rocky Mountain maple (*Acer glabrum*), box elder (*Acer negundo*), ash (*Fraxinus* spp.), and New Mexican locust (*Robinia neomexicana)*.

Coniferous Forests (transition) are found at elevations greater than 6,200 feet. Mean annual air temperature ranges from about 49° to 55° F. Mean annual precipitation ranges from about 20 to 26 inches. The dominant native vegetation is a mix of manzanita (*Arctostaphylos* spp.), Arizona white oak (*Quercus grisea*), silver leaf oak (*Quercus hypoleucoides*), alligator juniper (*Juniperus deppeana*), pinyon pine (*Pinus cembroides*), Chihuahua pine (*Pinus leiophylla*), and ponderosa pine (*Pinus ponderosa*).

Coniferous Forests (mixed conifer) are found at elevations greater than 7,200 feet. Mean annual air temperature ranges from about 45° to 52° F. Mean annual precipitation is about 30 inches. The dominant native vegetation is ponderosa pine (*Pinus ponderosa*), alligator juniper (*Juniperus deppeana*), gambel oak (*Quercus gambelii*), and Douglas-fir (*Pseudotsuga menziesii*).

Coniferous Forest (spruce-fir) are found at elevations greater than 8,200 feet. Mean annual air temperature ranges from about 45° to 52° F. Mean annual precipitation is about 35 inches. The dominant native vegetation is Engleman spruce (*Picea engelmanii)*, corkbark fir (*Abies lasiocarpa var. arizonica)*, Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*) and aspen (*Populus tremuloides*).

Dry Desert Riparian are found at elevations less than 5,200 feet. Mean annual air temperature ranges from about 66° to 72° F. Mean annual precipitation ranges from about 8 to 10 inches. The dominant native vegetation is mesquite (*Prosopis* spp.), desert willow (*Chilopsis linearis*), seep willow (*Baccharis glutinosa*), and desert broom (*Baccharis sarothroides)*.

Deciduous Riparian areas are found at elevations greater than 4,200 feet. Mean annual air temperature ranges from about 56° to 64° F. Mean annual precipitation ranges from about 12 to 16 inches. The dominant native vegetation is Fremont cottonwood (*Populus fremontii*), and Arizona Sycamore (*Platanus wrightii)*.

Evergreen Riparian (higher ecosystem extensions) areas are found at elevations greater than 4,200 feet. Mean annual air temperature ranges from about 54° to 58° F. The dominant native vegetation is Emory oak (*Quercus emoryi*) and alligator juniper (*Juniperus deppeana*).

Coniferous Riparian (combinations of riparian obligate species in both ponderosa pine/Douglas-fir forest and pine/oak/juniper woodland communities) areas are found at elevations greater than 5,200 feet. Mean annual air temperature ranges from about 46° to 52° F. The dominant native vegetation is Arizona sycamore (*Platanus wrightii*), Rocky

Mountain maple (*Acer glabrum*), aspen (*Populus tremuloides*), ash (*Fraxinus* spp.), Arizona alder (*Alnus oblongifolia*) and Arizona cyprus (*Cupressus arizonica*).

Environmental Consequences – Forest Plant Communities

Direct and Indirect Effects

Alternative 1: No Action

This alternative would not control invasive species above existing low levels. Populations of invasive species already present on the Forest would increase in size and density as well as spread to new locations through transportation of seed through the typical vectors of spread (vehicles, animals, wind, water, etc.). New species of invasive plants would likely be introduced to the Forest over the 10-year term of the analysis and would increase in population size and density, crowding out native plant communities. Low elevation disturbed sites would be most vulnerable to invasive species colonization, and these areas would be impacted earliest and most seriously. Based on past observed increases, sweet resinbush in particular is expected to increase in distribution. As sweet resinbush plants become established, they exclude nearly all species of native plants, forming a monoculture. Infestations of other invasive species would initially be introduced along roads and trails and in grazing allotments. Higher elevation sites with fewer disturbances and fewer vectors of spread (vehicles, hikers, livestock, etc.) would be less impacted by the spread of invasive species, although these vegetation types would not be unaffected over the long term.

The adverse impact on native plant communities would become increasingly apparent over the life of the analysis. In general, studies show that the cover and diversity of native plant species is reduced as invasive species spread (Belcher and Wilson 1989). Those plant communities dominated by exotic species would form a homogenous, monoculture-like habitat with reduced structural diversity (Belcher and Wilson 1989). The shifting dynamics and diverse habitats of riparian areas render them particularly susceptible to invasion by noxious weeds. Saltcedar and Johnson grass populations now found on the Forest would continue to produce seed in riparian zones. This seed would wash down stream during heavy rain events, causing populations to spread on to private lands and other state and federal lands. Disturbance from livestock grazing and hooves would facilitate germination of weed seeds and establishment of new infestations. Populations of Johnson grass would increase in riparian areas, shading out native species.

Key forage species would be reduced in rangelands on the Forest. Noxious weeds have little palatability, so forage losses would also adversely affect native ungulates. Non-infested vegetation would be subject to greater use by herbivores. This could increase removal of desirable vegetation and trampling of vegetation and soils.

Vegetation changes produced by invasive species would alter fire regimes at infested sites (Van Devender 1997). A greater quantity and continuity of fine fuel is produced by stands of exotic vegetation such as bufflegrass. Consequently there is a higher frequency of damaging fires during which native perennials may be negatively impacted. Fire frequency in Sonoran desert habitats invaded by buffelgrass would increase as fine fuels build. Most of the dominant plants in the desert communities (Saguaro, palo verde and brittle bush, for example) are readily killed by fire. The ecological result of the introduction of buffelgrass into fire-intolerant communities has been the conversion of these communities to an African-like savannah with drastically reduced standing crop biomass and overall diversity (Van Devender 1997).

Predictions regarding the rate of spread of noxious weeds in the Forest cannot accurately be made. However, examples from other areas can provide indications. Leafy spurge was unreported in Montana in 1920. In 1990, there was an estimated 1.5 million acres infested. It has been estimated that in the western United States, the total area infested by noxious weeds is expanding by 14 percent annually (Westbrooks 1998).

Alternative 2: Integrated Vegetation Management Excluding Herbicides

This alternative would slow the rate of spread of some weed populations. However, because many infestations would not be completely controlled or eliminated through mechanical control (e.g. Canada thistle, Johnson grass), a long-term expansion of noxious weeds into suitable habitats may be expected. Past efforts at controlling sweet resinbush on the Safford Ranger District through a combination of hand removal and fire have proved to be largely unsuccessful. Over the long term, the spread of invasive species is expected to continue, contributing to changes in plant species diversity and fire regimes that may negatively impact native plant communities, including sensitive species.

Alternative 3: Integrated Vegetation Management

A fully integrated approach to prevention, early detection and eradication of early-detected invasive species represents the most efficient and cost effective weed control available (BLM 1996). Consequently this program would provide the greatest long-term protection to the integrity of the native plant communities. Range condition would also be protected most effectively with this alternative. Follow up treatments will be need at infested sites, since application of herbicide or manual control methods will not generally eliminate target species in one effort, particularly if seed has been produced and is now present in the soil. Follow up treatments are generally not as intensive as initial treatments, but infestations will quickly return to fully occupy the site without them. It is necessary to continue to control weeds and prevent seed production until every seed on the site has either germinated or become non-viable. Complete recovery of reclaimed sites may require revegetation of desired plant species, either by natural regeneration of natives or by planting desirable species or non-viable cover crops.

Mechanical treatments that would occur with selection of this alternative may result in the removal or damage of some native vegetation. However these areas would be small and the impacts short-lived.

At herbicide treatment sites, non-target vegetation may be impacted. Herbicide selection will be made based on the site conditions and type of invasive species to be controlled. The most effective herbicide with the lowest impact on non-target vegetation will be selected. Application rates and the timing of applications will be selected to minimize effects to non-target species. Notwithstanding this, some impacts to non-target vegetation are unavoidable with herbicide application. The proposed spot treatment of many weed populations and mitigation features included in the design will allow the Forest to minimize herbicide effects to vegetation outside of the immediate vicinity of target plants. Impacts to native plant communities would be vastly less than with selection of the first two alternatives.

Use of glyphosate and imazapyr will be minimized since these two chemicals are broad spectrum herbicides, killing almost all vegetation. Localized application of these two herbicides can be a very effective tool within riparian zones and for treatment of cut stumps. Broadcast application of these chemicals will not be used.

The effectiveness of control treatments would be influenced by many factors including funding levels, the extent and success of repeat treatments, the effort exerted in mapping and monitoring of infestations, the extent of preventative measures implemented, the amount and degree of success of cooperative working agreements across multiple ownerships, and the amount of effort to search for and control new populations and species of invasive plants. Inventory and mapping of infestations would increase the chance of containing and confining weed infestations. Use of the preventive measures listed in Appendix C would reduce the influx of weeds, leaving fewer infestations to manage. Prevention of introduction and spread of invasive species is the single most effective and inexpensive method of invasive species management and is an important part of any integrated pest management strategy. Cooperative working agreements with adjacent landowners is critical to the success of weed management. Lands with unmanaged infestations become seed sources for dispersal to adjacent areas. As infestations increase on unmanaged lands, the influx of weed seed to neighboring areas becomes overwhelming.

Threatened, Endangered and Sensitive Plants
Affected Environment – TEPS Plants

A total of 93 Threatened, Endangered, Proposed or Forest Service Sensitive (TEPS) plant species occur or potentially occur on the Coronado National Forest. In order to determine which species may be potentially affected by the proposed action, all known sensitive plant species within one mile of any proposed weed treatment location were identified using the Forest Geographic Information System (GIS) database. Weed locations were derived from the 1999 survey of weeds on the Forest (Doc. 6). Realistically, since all proposed treatments will be targeted on individual weed plants at specific sites, effects to species not in the immediate vicinity of the treatment activity will likely be confined to the immediate treatment vicinity. Nevertheless, a one-mile radius was selected to ensure full consideration of species potentially in the area. Sensitive plants were identified within one mile of proposed treatment sites in five of the seven EMAs. These were Huachuca (Huac), Tumacacori (Tuma), Santa Catalina (Scat), Santa Rita (Srit) and Pinaleno (Pina). No species were identified within one mile of weed treatment sites in the Chiricahua and Peloncillo sites. The 30 species selected for analysis include 29 Forest Service Sensitive (S) species and one listed Endangered species, *Liliopsis schnaffneriana*, and are shown in Table 7.

Table 7. Coronado National Forest sensitive plant species potentially affected by proposed noxious weed treatments.

Species	Status	EMA of Occurrence	Associated Weeds
Abuliton parishii Pima Indian mallow	S	Scat, Srta	Bufflegrass Fountain Grass
Agave parviflora parviflora Santa Cruz striped agave	S	Tuma	Tree of Heaven
Amoreuxia gonzalezii Saiya	S	Srta	Bufflegrass
Amsonia grandiflora	S	Tuma	Tree of Heaven

Species	Status	EMA of Occurrence	Associated Weeds
Large-flowered blue star			
Astragalus hypoxylus Huachuca milkvetch	S	Huac	Tree of Heaven
Carex ultra Arizona giant sedge	S	Huac	Giant reed
Coryphantha recurvata Santa Cruz beehive cactus	S	Tuma	Tree of Heaven
Erigeron arisolius Arid throne fleabane	S	Srta	Tree of Heaven
Eupatorium bigelovii Bigalow thoroughwort	S	Pina	Canada thistle
Graptopetalum bartramii Bartrom stonecrop	S	Tuma	Tree of Heaven
Hedeoma dentatum Mock pennyroyal	S	Tuma, Huac, Scat	Tree of Heaven Bufflegrass
Heuchera glomerata Arizona alum root	S	Pina	Salt cedar
Ipomea thurberi Thuber's morning glory	S	Tuma	Tree of Heaven
Laennecia eriophylla Wooly fleabane	S	Srta	Fountain grass
Lilaeopsis schnaffneriana ssp. recurvata Huachuca water-umbel	LE	Huac	Giant reed
Lotus alamosanus Alamos deer vetch	S	Tuma	Tree of Heaven
Macroptilium supinum Supine bean	S	Tuma	Tree of Heaven
Manihot davisiae Arizona manihot	S	Scat, Srta	Bufflegrass Fountain grass
Metastelma mexicanum Wiggins milkweed vine	S	Tuma	Tree of Heaven
Muhlenbergia duboides Box canyon muhly	S	Scat	Bufflegrass Fountain grass
Pectis imberbis Beardless cinch weed	S	Tuma	Tree of Heaven
Penstemon discolor Catalina beardtongue	S	Scat	Bufflegrass Fountain grass
Penstemon ramosus Branching penstemon	S	Pina	Sweet resin bush
Polemonium flavum Pinaleno Jacob's ladder	S	Pina	Canada thistle
Potentilla albiflora White-flowered cinquefoil	S	Pina	Canada thistle
Rumex orthoneurus Blumer's dock	S	Pina	Canada thistle
Stevia lemmonii Lemmon's stevia	S	Scat	Bufflegrass Fountain grass
Tephrosa thurberi Thurber hoary pea	S	Huac	Tree of Heaven
Tragia laciniata Sonoran noseburn	S	Tuma, Huac	Tree of Heaven
Tumamoca mcdougalii Tumamoc globeberry	S	Scat	Bufflegrass Giant reed

More detailed descriptions of the 30 species are found in the Biological Assessment and Evaluation for this analysis (Appendix E). For the purposes of this analysis of the potential effects of noxious weed control activities on the sensitive plant resource, the habitats, known occurrences and known weed infestations associated with each of the 30 species constitute the affected environment.

Environmental Consequences – TEPS Plants

The application of selective and non-selective herbicides can directly cause injury or death to non-target plant species. Mechanical disturbance of the plant community can also result in impacts to non-target plants through soil disturbance or trampling. Post-treatment changes in the plant composition at the site of herbicide application and across the broader landscape are a potential consequence of weed eradication. These changes are, for the most part, believed to be beneficial to the extent they result in reductions of weed species, but may result in the loss of vegetative cover unless revegetation action is taken. Environmental effects of the proposed action and alternatives analyzed for each of the sensitive plant species identified in Table 7. The analysis was based on the type of treatment and the proximity of TEPS plants to identified weed treatment sites. Two types of treatment are identified under the proposed action: Eradication of localized existing populations, and containment and control of more widespread populations. Effects to plant species are presumed to be similar for both types of treatments, so they are not broken out in the following analysis.

For all action alternatives mitigation measures identified in Chapter 2 of the EA will be followed.

Direct and Indirect Effects

Alternative 1: No Action

Under this alternative, there would be no direct effects on occupied or suitable habitats for TEPS plants on the Forest. Weed control practices would not change from current levels. The use of herbicides in administrative sites and developed recreation sites would continue at current levels. Because of the highly disturbed character of these sites, TEPS plants are not likely to occur.

The indirect effects of this alternative are related to the continued spread of weeds into the Forest and the effects of this infestation on sensitive plants and their habitats. Populations of invasive species would continue to expand into susceptible areas. The impacts to sensitive species would be dependant on the future dynamics of weed infestations, which are difficult to predict. In general, the effects described for this alternative in the preceding section are predicted to result in negative effects to sensitive species through loss of plant species diversity and cover and changes in fire regimes.

Alternative 2: Integrated Vegetation Management Except for the use of Herbicides

Weed treatment mitigation outlined in the proposed action would protect documented TEPS plant occurrences. On those few sites where weeds occur within the extent of a sensitive plant population, it is possible that some trampling of sensitive plants could occur during hand pulling of weeds. The effects to a very small number of individual plants will be localize and short-lived and are not expected to affect population viability for any of the species under consideration.

Over the long term, it is not likely that this alternative would be sufficient to contain or control existing populations of weeds where infestations are extensive. Mechanical removal of sweet resinbush on the Pinaleno EMA have not been shown to be effective at long-term control. Hand pulling of several species of weed in Sabino Canyon has been ongoing, but at best, it has only kept pace with the rate of weed expansion in the canyon. Prevention measures and education will help to reduce the rate of introduction of new populations; however it is likely that weed populations would continue to expand from existing source populations within the Forest.

Alternative 3: Integrated Vegetation Management

Direct effects of the proposed action on special status plants would be almost entirely related to the effects of herbicide application on non-target plant species. Direct effects could occur from the broad non-selective spraying over wide areas. However, under the proposed action, treatments are restricted to the spot treatment of individual plants so very little herbicide drift would be expected. Tree of heaven treatments would involve cutting or pulling of individual trees and painting stumps with glyphosate, a technique which will eliminate the potential for herbicide application to non-target species. Fourteen of the 30 species identified in Table 4 are associated with Tree of Heaven, and no direct effects are expected to these species. The greatest potential for effects to non-target plant species exists in the Pinaleno EMA where sweet resinbush occurs in stands covering hundreds of acres. Because treatments would cover a wide area, some mortality to non-target species is expected. However, there are no known records of TES plants within the treatment area and mitigation measures described in Chapter 3 are designed to minimize the effects.

Based on records available for the occurrence of TEPS plants associated with noxious weed locations, it is unlikely that sensitive plants will occur in close association with any weeds; however, in order to minimize effects, all treatment areas will be surveyed for sensitive plant species prior to treatment as described in the mitigation measures section in Chapter 3.

Other direct effects include possible trampling or other physical damage to TEPS plants occurring adjacent to weed treatment areas during cutting or pulling of weeds. The localized nature of these effects, combined with pre-treatment surveys for sensitive plants, should minimize mechanical effects. The effects to a very small number of individual plants are not expected to affect population viability for any of the species under consideration. Physical damage to plants is anticipated to be less than that expected under Alternative 2, since a greater percentage of plants would be treated with herbicides that require less ground disturbance.

Removal of noxious weeds through any of the proposed treatment methods is not expected to have a long-term adverse effect on any sensitive plant species' habitat. Removal of competitive weed species should increase the potential for colonization of the site by native plants, including, potentially, sensitive species.

Containment of existing weed species could help prevent the spread of weeds further into more natural habitats. This would benefit individual species such as *Penstemon discolor* populations along the Catalina Highway where bufflegrass and fountain grass are increasing. Successful eradication or containment of invasive species would reduce the risk for catastrophic fires in fire-intolerant communities and help to perpetuate these natural communities, leading to overall greater plant community diversity on the Forest.

Successful eradication of small populations of tree of heaven, yellow starthistle, Canada thistle, buffelgrass, fountain grass and Johnson grass will eliminate source populations for the further spread of these species on to the Forest.

Cumulative Effects -Vegetation

A cumulative effect results from the effect of the proposed action when added to the effects of other past, present and reasonably foreseeable future actions (40 CFR 1508.7). The effects of Alternatives 1, 2 and 4, when added to the effects of the ongoing weed eradication efforts at administrative and recreational sites would represent a cumulative effect. It is unlikely that the sum of the effects of the treatment efforts would rise to the level of significance, although assuming successful treatment, the total amount of weeds treated would be greater than either of the two efforts taken individually. The possible future application of herbicides to public road rights of way within the Forest is currently being evaluated under a separate environmental analysis. Treatments will be confined to federal and state highway rights of way, which are limited on the Forest. Treatment of public roadways, if it occurs, may increase the amount of land treated on the Forest, but activities will be confined to roadsides. Very few sensitive plant species are known to occur in the highly disturbed areas adjacent to public roads where treatments will occur, so effects to sensitive native plants are expected to be negligible. However, these treatments, if they occur, would help to reduce the spread of invasive species from roadsides where they often first establish.

Other past, present and future activities that may contribute cumulative effects to vegetation and sensitive plants include recreation and grazing management activities. Recreation can disturb soils and create conditions to the introduction of invasive species. Recreationists, their vehicles and pets can act as vectors for the dispersal of weed seeds from other areas. Likewise, livestock grazing can contribute to the introduction and spread on nonindigenous plants by transporting seeds into uninfested sites, disturbing the soil and preferentially grazing native plants over weed species (Belsky and Gelbard 2000). On areas of the Forest where grazing occurs, livestock may continue to contribute to the spread of invasive species. Incorporation of the prevention measures outlined in alternatives 2 and 3 should provide some mitigation of this effect. Several of the known locations of invasive plants are currently ungrazed (Sabino Canyon and the front range of the Catalina Mountains) so livestock grazing is not expected to contribute cumulatively to the spread of weeds in these areas.

Wildlife (Issue 2)

Noxious weeds and exotic invasive plants provide little value as food or cover for native wildlife relative to native plant communities and often replace more valuable native plant species. The sites proposed for treatment are usually sites that have been disturbed by human activity (campsites, roadways and old home sites) and/or are subject to ongoing disturbance by human activity (e.g. Sabino Canyon). Nevertheless, a range of wildlife species may be present on or adjacent to sites proposed for treatment. Both aquatic and terrestrial species may be affected and effects may include the following:

- Changes in habitat composition and structure resulting from noxious weed treatments;

- Direct effects on wildlife from chemical treatments;
- Direct effects on wildlife from disturbance associated with treatments.

The scope of the analysis is influenced by the type of the treatment and the species being affected. For purposes of delineating the geographic scope of the analysis, all known TES species occurring within one mile of identified weed treatment sites were identified using the Forest GIS database. The habitats and known occurrences of wildlife species within one mile of treatment sites constitute the affected environment. In reality, weed treatments will be site-specific and effects are not expected to extend beyond the treatment site and the immediately adjacent area. Nevertheless, a one-mile buffer will insure consideration of a full range of species potentially affected by the proposed action.

The following analysis first describes the affected environment for Threatened, Endangered, Proposed and Sensitive (TEPS) aquatic wildlife, TEPS terrestrial wildlife and Management Indicator Species (MIS). Following that, the environmental effects of the proposed action and alternatives are described individually for both terrestrial and aquatic wildlife.

Affected Environment

Threatened, Endangered, Proposed and Forest Service Sensitive aquatic organisms.

Noxious weed infestations in aquatic habitats are restricted in size and distribution on the Forest. Identified species areas for priority treatment include Redrock Canyon (Johnson grass) and the Van Horn exclosure (giant reed) in the Huachuca EMA, and lower Sabino and Bear Canyons in the Santa Catalina EMA where populations of Giant reed, sweet resin bush, Bufflegrass and Pentzia are present. Aquatic vertebrate species present and potentially affected in Redrock Canyon include the Endangered Gila topminnow (*Poeciliopsis occidentalis occidentalis*) and Long-finned dace (*Agosia chrysogaster*), a Forest Service Sensitive species. In the Sabino Canyon area, occupied or potential habitats have been documented for the Proposed Endangered Gila chub (*Gila intermedia*), Lowland leopard frog (*Rana yavapaiensis*) and the Sabino Canyon damselfly (*Argia Sabino*), both Forest Service Sensitive species. Because of the potential for downstream transport of herbicides away from treatment sites, the affected environment for aquatic species includes species and habitats located downstream from treatment areas.

Threatened, Endangered and Forest Service Sensitive terrestrial wildlife and invertebrates.

Within the affected environment for the proposed action, occupied or potential habitats for 18 terrestrial TEPS species have been identified. These species are displayed in Table 8.

Table 8. Coronado National Forest Threatened, Endangered Proposed and Sensitive terrestrial species potentially affected by proposed noxious weed treatments.

Species Name	Status	EMA of Occurrence	Associated Noxious Weeds	Comments
Mount Graham red squirrel *Tamiasciuris hudsonicus*	LE	Pina	Canada thistle	Occupied and potential habitats are found near Canada thistle sites, but the thistle occurs in open, disturbed

Species Name	Status	EMA of Occurrence	Associated Noxious Weeds	Comments
				sites that are not generally suitable as red squirrel habitat.
White-bellied long-tailed vole *Microtus longicaudus leucopheaus*	S	Pina	Canada Thistle	Species inhabits grassy alpine meadows and flats along streams, cienegas, roadsides and other openings in the conifer forest on the Pinaleno Mountains.
Lesser long-nosed bat *Leptonycteris curasoae yerbabuenae*	LE	Tuma	Tree of Heaven	Suitable habitats may be present near most weed treatment sites except for high elevation Canada thistle sites.
Mexican spotted owl *Strix occidentalis lucida*	LT	Huac, Tuma, Scat, Pina, Chir	Tree of Heaven Canada thistle	Management territories mapped near Harshaw and on Mount Graham. Single bird observed in Sabino Canyon (Scat) in 1991; no occupied habitat.
Northern goshawk *Accipiter gentiles apache*	S	Huac, Pina	Tree of Heaven Canada thistle	Occupied territories within one mile of treatment site.
American peregrine falcon *Falco peregrinus anatum*	S	Scat	Bufflegrass Fountain grass	Nests throughout Forest in suitable habitat.
Cactus ferruginous pygmy owl *Galaucidium brasilianus cactorum*	LE	Scat	Bufflegrass Giant reed Pentzia	A single record from 1976 in Sabino Canyon. No recent observations.
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	S	Tuma, Huac	Tree of heaven	Occupied and potential habitats in vicinity.
Northern gray hawk *Asturina nitida maxima*	S	Huac	Johnson grass	Nests within one mile of treatment site.
Mexican garter snake *Thamnophis eques megalops*	S	Huac	Tree of Heaven	Suitable aquatic habitat not present at site.
Arizona ridge-nosed rattlesnake *Crotalus willardi willardi*	S	Huac	Tree of Heaven	Documented within one mile. Suitable habitat not present at site.
Chiricahua leopard frog *Rana chiricahuensis*	LT	Tuma, Chir	Tree of Heaven	Documented within one mile, but suitable aquatic habitat not present on site.
Lowland leopard frog *Rana yavapaiensis*	S	Scat	Giant reed Bufflegrass Pentzia	Documented within one mile in Sabino Canyon in 1980. No recent records.
Western barking frog *Eleutherodactylus augusti cactorum*	S	Tuma	Tree of Heaven	Old record from 1965 within one mile. No recent records; suitable habitat not present on site.
Gila chub *Gila intermedia*	P	Huac, Scat	Buffelgrass Giant reed Pentzia	Occupied habitats in Sabino Creek and O'Donnell Creek.
Sabino Canyon damselfly *Argia Sabino*	S	Scat	Bufflegrass Giant reed Pentzia	Species and suitable habitats present.

Species Name	Status	EMA of Occurrence	Associated Noxious Weeds	Comments
Pinaleno mountainsnail *Oreohelix grahamensis*	S	Pina	Canada thistle	Found in leaf litter around rockslides. No suitable habitat present.
Pinaleno tallussnail *Sonorella grahamensis*	S	Pina	Canada thistle	Inhabits rockslides. No suitable habitat present.
Mimic tallussnail *Sonorella imitator*	S	Pina	Canada thistle	Inhabits rockslides. No suitable habitat present.

Management Indicator Species (MIS)

The Forest Service Manual (FSM) defines management indicator as "plant and animal species, communities or special habitats selected for emphasis in planning, and which are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent." (FSM 2620.5). The Coronado National Forest Plan identifies 33 Management Indicator Species and one group (cavity nesters) to fill this role (Appendix F). By definition, MIS are species that represent a broader suite of species that share similar habitat affinities and for which the effects of the proposed action and alternatives are considered similar. The analysis area supports an abundance of species that may be affected by the proposed action and alternatives. For the purposes of this analysis, effects to MIS are presumed to be representative of effects to other species with similar habitat needs.

Several TES species discussed above are also MIS on the Forest. Those species are **northern gray hawk, American peregrine falcon, Mount Graham red squirrel, Arizona ridge-nosed rattlesnake, western barking frog, Gila topminnow** and **Gila chub**. The above-listed species are all included in the "threatened and endangered species" indicator group in the Forest Plan. In addition, the **gray hawk** is an indicator for riparian habitats. Suitable habitats for the following additional MIS have been identified as occurring within the analysis area.

- **Elegant Trogon**: Cavity nesters, Riparian, Species needing diversity, Special Interest Species, Threatened and Endangered Species.
- **Sulphur-bellied flycatcher**: Cavity nesters, Riparian, Species needing diversity, Special Interest Species, Threatened and Endangered Species.
- **Black Bear**: Riparian, Species needing diversity, Game Species.
- **White-tailed deer**: Species Needing Diversity, Species Needing Herbaceous Cover, Game Species.
- **Mearns' quail**: Species Needing Herbaceous Cover, Game Species, Special Interest Species.

Forest-wide trends of all MIS have been assessed and are reported in the Forest-wide Status Report for Management Indicator Species (USFS 2002). The background information and conclusions of this report are incorporated by reference and the entire document is contained in the project record for this analysis (Doc.74). Project level impacts to selected MIS as a result of this proposal have been evaluated and are reported in the Wildlife Specialist's Report, found in the project record (Doc. 67). Effects are summarized herein.

Environmental Consequences - Terrestrial Wildlife

This section evaluates the environmental consequences of all alternatives to terrestrial wildlife. The information included in the analysis is based on the Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4 and 10 and on Bonneville Power Administration Sites (USDA Forest Service 1992). Regulations to implement the National Environmental Policy Act (NEPA) provide for the reduction of bulk and redundancy through incorporation by reference when the effect will be to reduce the size of the document without impeding agency of public review of the action (40 CFR 1502.21). Portions of the Risk Assessment are displayed in the following analysis, but the entire document is incorporated by reference.

The majority of weed infestation sites on the Forest at this time do not provide high quality wildlife habitat. By their nature, most sites have undergone past physical disturbance or are subject to high human activity and disturbance levels (e.g. Sabino Canyon). Many sites are along well-traveled roadways. In some cases, the presence of the weeds themselves contributes to degraded site conditions and habitats would improve with the removal of weeds. Tree of Heaven is allelopathic (it suppresses the growth of nearby plants); sweet resin bush and bufflegrass tend to form extensive monocultures that reduce plant diversity and degrade habitat value for native species. In addition, most weed sites are very localized at present.

Direct and Indirect Effects

Alternative 1 - No Action

Under the No Action Alternative, there will be no direct effects to terrestrial wildlife species from treatment activities. Individual populations of noxious weeds may continue to be treated using a variety of methods, including herbicides. However, each treatment would be evaluated and authorized under a separate analysis. A strategic, programmatic approach to integrated vegetation management would not be taken. Given existing workloads, it is not likely that individual analyses and treatments would proceed with sufficient speed to have a significant effect on invasive plant infestations. Herbicides and other weed treatments may continue to be used in administrative sites and developed recreation areas, but would be insufficient to treat major areas of weed invasion.

It is likely that treatment activities will continue to remain at existing levels and that noxious weed populations will continue to expand on the Forest. This would result in a reduction of desirable native habitats. Monocultures of invasive species, especially sweet resinbush and buffelgrass would continue to expand and new populations of invasive plants would become established. Palatable forage for game and non-game species of wildlife would likely decrease. Natural habitat for wildlife would be lost as nesting and ground cover, grass production, seed producing food sources, and prey base would be reduced. Westbrooks (1998) reported that stands of the Lehmann lovegrass were shown to have fewer quail, small mammals and seed-harvesting ants. Elk pellet-group densities averaged 81% lower in infested sites than in non-infested sites and biomass of key forage species was reduced from 77% to only 4% of total biomass in sites heavily infested with leafy spurge in a study in North Dakota (Trammell and Butler 1995). The continued spread of invasive species at lower elevations may contribute to increasing fire frequency in fire-intolerant Sonoran desert habitats, leading to a loss or degradation of these areas as wildlife habitat.

This alternative would cause the highest level of degradation of forage and habitat for wildlife species over time.

Alternative 2: Integrated Vegetation Management excluding the use of Herbicides.

The direct effects of cultural, physical and biological treatments to wildlife species are expected to be minimal, and confined to short-term displacement of individual animals. Manual and mechanical treatments will be of short duration and confined to relatively small areas. In the short term, some minor soil disturbance would be expected and in areas where weeds form a monoculture, removal of large amounts of plant cover may leave the soil surface susceptible to erosion. Site disturbance may be somewhat greater under this alternative, since manual treatment is more labor-intensive, and will probably result in greater disturbance of the soil on the site. Areas such as this would be revegetated under the integrated vegetation management approach, so the potential for soil loss would be minimized.

The indirect effects of treating vegetation under this alternative are expected to involve long-term changes in the plant community, but to a lesser degree than those described under either Alternatives 1 and 3. Where weeds can eliminated or controlled through manual or mechanical treatments, the potential will exist for the establishment of native wildlife habitats, especially in areas where restoration involves replanting of native species. There is a potential for increased soil disturbance under this alternative, since much of the work would involve cutting or grubbing of entire plants. Many of the species in this analysis have been shown to be resistant to mechanical treatments because they are prolific seed producers or are cabable of spreading through rhizomes, thus requiring repeated treatments to be effective. Areas that require repeated treatments would result in long-term soil disturbance on the sites. The potential for successful treatment of invasive species is reduced under this alternative, compared to the proposed action.

Over the long term, areas of extensive weed infestations would persist because their size would preclude effective control using manual methods alone.

Alternative 3: Integrated Vegetation Management.

Wildlife exposure to herbicides can occur through direct skin contact (dermal exposure), ingestion of herbicide-contaminated forage, inhalation of aerial spray or a combination of the above routes. The USDA Forest Service Risk Assessment for Herbicide Use (Risk Assessment) evaluated the toxicity to terrestrial and aquatic wildlife and invertebrate species of 21 herbicides, 3 carriers and one additive proposed for use by the Forest Service in the Rocky Mountain Region. For the purposes of the Risk Assessment, all herbicide treatments were assumed to involve broadcast applications from aircraft. Ground-based, site specific applications, as proposed on the Coronado National Forest, were considered to have a very low potential to affect wildlife because of the reduced likelihood of an animal receiving a direct spray of herbicide and because of the much reduced size of the treatment area.

Because aerial application is not being proposed on the Coronado National Forest, the most likely exposure route for wildlife species will be from the ingestion of herbicide contaminated forage. Wildlife can ingest herbicides directly by consuming contaminated plants or indirectly through the consumption of a prey species that has eaten contaminated forage (such as an owl eating a mouse that has consumed treated plants).

The exposure risk to terrestrial and aquatic wildlife and invertebrates is a function of the toxicity of the herbicide to each organism and the exposure each organism is subjected to as a result of the treatment. Toxicity is expressed in terms of the LD_{50}s for different species. LD_{50}s are defined as the median lethal doses – the single oral or dermal doses calculated from a series of tests to be lethal to exactly 50% of a test animal group. In many cases, toxicity studies for specific wildlife species were lacking, so the results of studies using domestic laboratory animals were used in the Risk Assessment. To the greatest extent possible, toxicity data on the most closely related avian or mammalian species were used for the wildlife risk comparisons. The effects on domestic species are considered comparable to the effects that would occur in similar species in the wild (USDA 1992). In general, toxicity for rats, mice and rabbits were often used to represent effects to wild mammals; mallard duck, bobwhite quail, chicken and pheasant were used to determine toxicity for wild avian species and for reptiles. Table 9 displays calculated acute oral toxicity (LD_{50}) values for 21 herbicides on a variety of species used as wildlife toxicity surrogates in the toxicity and exposure analysis.

The other half of the risk equation – exposure – was calculated for a number of wildlife species for three major exposure routes: dermal, ingestion and inhalation. Because the herbicides degrade relatively rapidly and sites are normally treated once per year, no analysis of chronic exposure was performed. The herbicides show little tendency to bio-accumulate, so long term persistence in the food chain was not considered in the analysis (USDA 1992).

Two levels of exposure were analyzed: For *typical doses*, dermal exposures were based on levels of herbicide likely to be found on vegetation surfaces, assuming the animals would seek cover during a spraying operation. Ingestion doses were calculated assuming a percentage of the animals daily food intake was contaminated. The larger and more wide-ranging the animal, the lower the estimated percentage. *Extreme doses* were calculated assuming the animals did not seek cover and thus received a full dose of herbicide over their entire body surface. In the extreme ingestion case, animals were assumed to feed entirely on contaminated forage. Predators were assumed to receive the entire body burden that each prey species had received through oral, dermal and inhalation exposure. Inhalation doses were also calculated based on a hypothetical cloud of aerial spray, but are not considered in this analysis because no aerial application is proposed.

The Risk Assessment then compared estimated exposures to the acute toxicity levels determined for a variety of species through laboratory studies. The EPA assessed the risk of pesticide exposure according to the following criteria:

Low: Expected Dose $< 1/5$ of LD_{50}

Moderate: Expected dose between 1/5 LD_{50} and LD_{50}

High: Expected Dose $> LD_{50}$

Exposure doses below one fifth of the LD_{50} level were assumed to present a low or negligible risk, doses between one fifth of the LD_{50} and the LD_{50} were assumed to present a moderate risk that may be mitigated through restrictions on the use and application of the herbicide, and doses above the LD_{50} are assumed to present an unacceptably high risk.

Table 9 displays the calculated LD_{50}s, estimated exposures and risk assessments for selected species and herbicides as presented in the Risk Assessment. The eight herbicides displayed in Table 9 are those considered most likely to be used in treatments on the Forest. As stated above, estimated exposures, both typical and extreme, are based on an assumed aerial application of herbicides, which is not proposed for the Forest. Herbicide exposures to wildlife on the Coronado National Forest are projected to be well below even that shown for the "typical" exposure calculated in the risk assessment. Even assuming aerial application, for all 21 herbicides and carriers/additives analyzed in the Risk Assessment, the typical dose estimates are below the EPA risk criterion of 1/5 LD_{50} and are far below the laboratory LD_{50}s.

Table 9. Estimated lethal doses (LD50s), estimated exposures and risk assessments for selected herbicides and representative wildlife species based on the 1992 Risk Assessment for Herbicide Use in Regions 1,2,3,4 and 10 (USDA 1992). Estimated exposures are based on a combination of oral, dermal and inhalation exposures resulting from a hypothetical aerial application of herbicide at typical rates.

	Flicker				Quail			
Chemical	LD_{50} (mg/kg)	1/5 LD_{50}	Est. Exp.	Risk Asses.	LD_{50} (mg/kg)	1/5 LD_{50}	Est. Exp.	Risk Assess.
Glyphosate	Quail, >2000	400	58.7	Low	Quail, >2,000	400	5.1	Low
Dicamba	Pheasant, 673	135	6.1	Low	Bobwhite, >1,750	350	504	Low
Imazapyr	Bobwhite, >2,150	430	3.2	Low	Bobwhite, >2,150	430	2.8	Low
Picloram	Pheasant, >2,000	400	5.7	Low	Pheasant, >2,000	400	4.9	Low
Clopyralid	Duck, 1,465	293	0.8	Low	Duck, 1,465	293	0.7	Low
Metsulfuron methyl	Mallard, >2150	502	0.1	Low	Mallard, >2150	502	0.1	Low
2,4-D	Chukar, 200	40	6.1	Low	Quail, 668	134	5.3	Low
Tryclopyr	Mallard, 1,698	340	11.6	Low	Mallard, 1,698	340	10.0	Low
	Western Kingbird				American Kestrel			
	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses.	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses
Glyphosate	Quail, >2,000	400	15.1	Low	Quail, >2000	400	10.7	Low
Dicamba	Pheasant, 673	135	15.4	Low	Pheasant, 673	135	11.0	Low
Imazapyr	Bobwhite, >2,150	430	7.8	Low	Bobwhite, >2,150	430	5.6	Low
Picloram	Pheasant, >2,000	400	14.9	Low	Pheasant, >2,000	400	10.5	Low
Clopyralid	Duck, 1,465	293	2.0	Low	Duck, 1,465	293	1.4	Low
Metsulfuron methyl	Mallard, >2150	502	0.2	Low	Mallard, >2150	430	0.2	Low
2,4-D	Chukar, 200	40	15.3	Low	Chukar, 200	40	10.9	Low
Triclopyr	Mallard, 1,698	340	30.1	Low	Mallard, 1,698	340	21.2	Low
	Whitetail Jackrabbit				Mule Deer			
	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses.	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses
Glyphosate	Rat, 3,800	760	2.1	Low	Rabbit, 4,320	864	0.2	Low
Dicamba	Rabbit, 566	113	2.3	Low	Rat, 757	151	0.3	Low
Imazapyr	Rabbit, >4,800	960	1.2	Low	Mouse, 2,000	400	0.2	Low
Picloram	Rabbit, 2,000	400	2.0	Low	Sheep, 720	144	0.2	Low
Clopyralid	Rat, >4,300	860	0.3	Low	Rat, >4,300	860	0.04	Low
Metsulfuron methyl	Rat, 5,000	1,000	0.04	Low	Rat, 5,000	1,000	0.01	Low
2,4-D	Rabbit, 424	85	2.2	Low	Mule deer, 400	80	0.3	Low
Tryclopyr	Rabbit, 550	110	4.0	Low	Guinea Pig, 310	62	0.4	Low

	Coyote				Cow			
	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses.	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses.
Glyphosate	Rat, 4,320	864	0.6	Low	Rabbit, 3,800	760	0.15	Low
Dicamba	Rat, 757	151	0.7	Low	Rat, 757	151	0.2	Low
Imazapyr	Mouse, 2,000	400	0.4	Low	Mouse, 2,000	400	0.1	Low
Picloram	Mouse, 2,000	400	0.5	Low	Cattle, >750	150	0.1	Low
Clopyralid	Rat, >4,300	860	0.1	Low	Rat, >4,300	860	0.03	Low
Metsulfuron methyl	Rat, 5,000	1,000	0.01	Low	Rat, 5,000	1,000	0.003	Low
2,4-D	Dog, 100	20	0.7	Low	Cattle, 100	20	0.2	Low
Triclopyr	Guinea Pig, 310	62	1.1	Low	Guinea Pig, 310	62	0.3	Low
	Long-tailed vole				Western yellow belly racer			
	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses.	LD_{50}	1/5 LD_{50}	Est. Exp.	Risk Asses.
Glyphosate	Quail, >2,000	400	39.1	Low	Quail, >2,000	400	0.3	Low
Dicamba	Rat, 757	151	39.5	Low	Pheasant, 673	135	0.7	Low
Imazapyr	Mouse, 2,000	400	19.9	Low	Bobwhite, >2,150	430	0.5	Low
Picloram	Mouse, 2,000	400	38.8	Low	Pheasant, >2,000	400	0.1	Low
Clopyralid	Rat, >4,300	860	5.0	Low	Duck, 1,465	293	0.1	Low
Metsulfuron methyl	Rat, 5,000	1,000	0.6	Low	Mallard, >2150	502	0.01	Low
2,4-D	Mouse, 368	74	39.4	Low	Chukar, 200	40	0.6	Low
Triclopyr	Mouse, 471	94	77.9	Low	Mallard, 1,698	340	0.4	Low

There would be a low or negligible risk of toxic effects on birds and terrestrial mammals, including livestock, from the application of the herbicides proposed for use.

No direct effects are expected to terrestrial wildlife species as a result of manual treatment (hand pulling or cutting) of noxious weeds. Manual methods are expected to be used in areas of very localized infestations or where the presence of other sensitive resources precludes the use of herbicides. Some minor displacement of wildlife species may occur during weed treatment activities, but this disturbance would be of short duration and no different than other human uses of the site.

The indirect effects of treating vegetation under the proposed action are expected to involve long-term changes in the plant community. Where weeds are eliminated or controlled, the potential will exist for the establishment of native plant species, especially in areas where restoration involves replanting of native species. Over the long term, the restoration of native plant communities would be expected to increase the capability of weed infested sites to support native wildlife species.

Migratory Birds

Executive Order 13186, of January 10, 2001 directs Federal agencies to support migratory bird conservation and to "ensure that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern." Birds of Conservation Concern are identified by the U.S. Fish and Wildlife Service Office of Migratory Bird Management by Bird Conservation Region (USFWS 2002. Birds of Conservation Concern. Div. of Migratory Bird Management http://migratorybirds.fws.gov/reports/bcc2002). The Project area lies within the Sierra Madre Occidental Region. Thirty-nine birds of conservation concern are identified for this region (Doc. 75). Effects to selected migratory bird species were analyzed in the Wildlife Specialist's Report (Doc. 67), Biological Assessment and Evaluation (Doc. 76, Appendix E) by species and habitat type and are summarized above. Under all action alternatives including the proposed action, effects to migratory birds are anticipated to be insignificant or discountable. The design of the proposed action and mitigation features should preclude impacts as a result of herbicide exposure or disturbance. The effects of No Action are anticipated to be both positive and negative. Invasive species like buffelgrass can change the structure of shrub dominated drylands to a more savannah-like state, which may benefit some birds that require herbaceous cover. Alternatively, grass invaded desertscrub tends to have lower species diversity, lower productivity and lower standing crop biomass (Burquez-Montijo, et al 2002). Attendant changes in fire regimes will, over time, eliminate fire-intolerant native species with which native migratory birds evolved. In general, the continued spread of invasive plants will tend to eliminate habitats for native migratory birds.

Four officially identified important bird areas (IBA) are found on or near the Coronado National Forest (Doc. 75). These are California Gulch, the Chiricahua Mountains, the Santa Rita Mountains and Sycamore Canyon.. Two additional areas, upper San Pedro River and Arivaca Cienega/Arivaca Creek are near the Forest. Invasive plant management activities may occur within IBAs, but should not affect migratory birds for the reasons described above.

Cumulative Effects: Terrestrial Wildlife

The effects of Alternatives 1, 2 and 3, when added to the effects of the ongoing weed eradication efforts at administrative and recreational sites would represent a cumulative effect. It is unlikely that the sum of the effects of the treatment efforts would rise to the level of significance, although assuming successful treatment, the total amount of weeds treated would be greater than either of the two efforts taken individually. The possible future application of herbicides to public road rights of way within the Forest is currently being evaluated under a separate environmental analysis. Treatments will be confined to state highway rights of way, which are limited on the Forest. Treatment of public roadways would increase the amount of land treated on the Forest, but activities will be confined to roadsides. Very few sensitive plant species are known to occur in the highly disturbed areas adjacent to public roads where treatments will occur, so effects to sensitive native plants are expected to be negligible. However, these treatments, if they occur, would help to reduce the spread of invasive species from roadsides where they often first establish.

Other past, present and future activities that may contribute cumulative effects to vegetation and sensitive plants include recreation and grazing management activities. Recreation can disturb soils and create conditions to the introduction of invasive species. Recreationists, their vehicles and pets can act as vectors for the dispersal of weed seeds from other areas. Likewise, livestock grazing can contribute to the introduction and spread on nonindigenous plants by transporting seeds into uninfested sites, disturbing the soil and preferentially grazing native plants over weed species (Belsky and Gelbard 2000). On areas of the Forest where grazing occurs, livestock may continue to contribute to the spread of invasive species. Incorporation of the prevention measures outlined in alternatives 2 and 3 should provide some mitigation of this effect. Several of the known locations of invasive plants are currently ungrazed (Sabino Canyon and the front range of the Catalina Mountains) so livestock grazing is not expected to contribute cumulatively to the spread of weeds in these areas.

Overall, cumulative effects are anticipated to be greatest to wildlife under the no action alternative because the spread of invasive species will continue unabated and will be combined with the future effects of recreation, cattle grazing and other activities that contribute to the spread of invasive plants. In addition, an IVM approach would not be adopted, so preventative and cooperative measures would not serve to mitigate the spread of invasive species to any appreciable degree.

Environmental Consequences - Aquatic Wildlife.

Direct and Indirect Effects

Alternative 1. No Action

Under the No Action Alternative, individual populations of noxious weeds may continue to be treated using a variety of methods, including herbicides. However, each treatment would be evaluated and authorized under a separate analysis. A programmatic approach to integrated vegetation management would not be taken. Given existing workloads, it is not likely that individual analyses and treatments would proceed with sufficient speed to have a significant effect on invasive plant infestations. Herbicides and other weed treatments would continue to be used in administrative sites and developed recreation areas.

No direct effects are anticipated as a result of not adopting a programmatic approach to weed management. With regard to indirect effects, it is likely that treatment activities will continue to remain at existing levels and that noxious weed populations will continue to expand within aquatic environments on the Forest. Three species, Johnson grass, giant reed and salt cedar, are currently found in or near aquatic sites. These species have the potential to develop large monocultures that could eventually affect the functioning of the aquatic systems. Johnson grass tends to shade out other native species and would reduce diversity in aquatic sites if left uncontrolled. Salt cedar in large stands can crowd out native vegetation, increase salinity in riparian soils, and increase water consumption through transpiration, leading to the drying of springs and streams. The de-watering of wet sites through additional transpiration may have significant effects on native fish in places like Redrock Canyon where Gila topminnow populations are often restricted to a handful of pools during the summer dry season.

Alternative 2: Integrated Vegetation Management excluding the use of herbicides.

The proposed manual control of weeds is not expected to directly affect aquatic organisms. The proposed methods consist of hand-pulling individual plants or using hand tools to cut the plants. The hand-pulling of weeds adjacent to streambeds will loosen the soil and may contribute sediment to the stream. This disturbance will be minimal and of short duration.

Because of the low probability of weed treatments in and adjacent to aquatic sites, no indirect effects are anticipated as a result of treatment activities. Other indirect effects would be related to the effectiveness of the treatments at removing invasive species from aquatic sites. If treatments are effective, few indirect effects are anticipated. If manual treatments are not effective to control the spread of invasive plants, effects similar to those described under Alternative 1 would be expected. Three species included in the analysis, saltcedar, Johnson grass and giant reed, could potentially affect aquatic systems if allowed to spread. All three species are capable of reproducing vegetatively after cutting, so manual treatments alone may have limited success.

Alternative 3: Integrated Vegetation Management.

Herbicide applications provide perhaps the greatest risk to aquatic organisms. Herbicides can enter water sources through overspray, aerial drift, runoff after storm events and accidental spills. The degree of impact is influenced by the amount and type of herbicide being used, the volume of flow and the amount of mixing at the water source, and the type and abundance of organisms present in the aquatic site. The Risk Assessment (USDA 1992) analyzed potential impacts to fish and aquatic invertebrates using a process similar to that described above for terrestrial wildlife. For purposes of the assessment, it was assumed that a water body would receive a direct spray of herbicide in the course of an aerial application. Herbicide applications on the Coronado National Forest will be ground applications generally involving hand spraying of individual plants. Therefore, the potential that significant amounts of herbicide would enter water bodies is greatly reduced. Further, no locations for herbicide treatment of noxious weeds are currently proposed for aquatic sites. In the event that some herbicide use in or near aquatic environments becomes necessary in the future, buffers will be established as described in the mitigation features in Chapter 3. The following analysis is provided in the event that future treatments occur near aquatic sites.

The potential impact of herbicides proposed for use on fish and other aquatic organisms is a function of three factors: 1) Toxic characteristics of the active ingredient; 2) Amount of the active ingredient in the water where aquatic organisms live, and 3) Length of time an organism is exposed to the active ingredient.

Whether an organism is affected by an herbicide is generally measured in a laboratory using a "LC_{50}" test. The LC_{50} is the herbicide concentration that is lethal to 50 percent of the organisms expose to the active ingredient for a given time. Although the LC_{50} is frequently used as a toxicity standard, 50 percent mortality of fish or other aquatic organisms would not be acceptable under any circumstance on a National Forest. For this reason, biologists calculate a "No Observable Effect Level" (NOEL). This is the amount of active ingredient that would have no measurable effects on test organisms after several days of exposure.

The herbicides proposed for use are all characterized by relatively low aquatic toxicity under typical case water concentrations. The only exceptions is triclopyr, which may present a high risk for trout in streams and a moderate risk for trout in lakes. Picloram, dicamba, and 2,4-D may present a moderate risk under extreme water concentration, but this case seems highly unlikely under the conditions of proposed application. At typical application rates, the Rodeo formulation of Glyphosate was determined to be practically non-toxic to aquatic organisms (USDA 1992, SERA 1996).

While little or no herbicide spraying adjacent to aquatic sites is currently proposed, by limiting any future spraying to Rodeo or other herbicides approved for aquatic application, adverse direct effects to aquatic wildlife species will be minimized, if not entirely precluded. Since little or no on-site effects are anticipated, no downstream effects are expected as a result of the proposed action.

Herbicide applications near water will be by hand backpack applications, and this will result in minimal risk to contamination of surface water. With the exception of Picloram, leaching of herbicides through soil is not a significant process. Herbicides do have the potential for overland flow during heavy rainstorms, but the proposed application method of spraying individual plants makes water contamination unlikely. Mitigation measures will serve to reduce the potential for possible adverse effects to aquatic organisms. The adoption of management practices identified in the Safety and Spill Plan (Appendix D) will minimize the potential of spills.

The proposed manual control of weeds is not expected to affect aquatic organisms. The proposed methods consist of hand-pulling individual plants or using hand tools. Manual treatments will occur where weed densities are low or where the presence of rare plants would preclude the use of herbicides. The hand-pulling of weeds adjacent to streambeds will loosen the soil and may contribute sediment to the stream. This disturbance will be minimal and of short duration.

Cumulative Effects –Aquatic Wildlife

Other past, present and future activities that may contribute cumulative effects to aquatic resources include recreation and grazing management activities. Recreation can disturb soils and create conditions to the introduction of invasive species. Recreationists, their vehicles and pets can act as vectors for the dispersal of weed seeds from other areas. Likewise, livestock grazing can contribute to the introduction and spread on nonindigenous plants by transporting seeds into uninfested sites, disturbing the soil and preferentially grazing native plants over weed species (Belsky and Gelbard 2000). Riparian areas on the Forest are often heavily used by both recreationists and livestock attracted by shade and water. Incorporation of the prevention measures outlined in alternatives 2 and 3 should provide some mitigation of this effect.

Overall, cumulative effects are anticipated to be greatest to aquatic organisms under the no action alternative because the spread of invasive species will continue unabated and will be combined with the future effects of recreation, cattle grazing and other activities that contribute to the spread of invasive plants. In addition, an IVM approach would not be adopted, so preventative and cooperative measures would not serve to mitigate the spread of invasive species to any appreciable degree.

Water Quality (Issue 4)

Affected Environment - Water Quality and Quantity

The analysis area for water for this project is the entire Forest. The Forest includes parts of the following 5th Code Watersheds: Altar Wash, Animas Creek, Aravaipa Creek, Canada del Oro, Cienega Creek, Cloverdale Creek, Lower Gila River, Lower San Pedro River, Lower Santa Cruz River, Middle San Pedro, Middle Santa Cruz, Rillito Creek, Rio Altar, San Bernardino Valley, San Simon Creek, Sonoita Creek, Upper San Pedro River, Upper Santa Cruz River, Whitewater Draw and Willcox Playa. Units of measure for this resource are change in water quality.

Water quality is assessed by comparing existing conditions with desired conditions that are set by the States under the authority of the Clean Water Act. Impaired waters are identified in the Patagonia Mountains in Harshaw, Alum and Three R Canyons (Arizona

Water Quality Assessment, ADEQ 2002). Pena Blanca Lake and Arivaca Lake are rated as Not Attaining. An Impaired water does not maintain surface water quality standards for its designated uses, a Not Attaining water does not maintain surface water quality standards for its designated uses and a TMDL is in place (ADEQ 2002). The absence of Impaired Water or Not Attaining designations infers that water quality is acceptable for designated uses in the project area. With the exceptions of the waters listed above, water quality on the Forest is generally satisfactory.

Surface water on the Forest is generally ephemeral and present only during storms and snowmelt. Few of the streams flow continuously, although they may have water in them for several months each year and support short stretches that remain perennial. There are five small to medium sized impoundments managed as recreational fisheries. These are Arivaca and Pena Blanca Lakes in the Tumacacori EMA, Rose Canyon Lake in the Santa Catalina EMA, Parker Canyon Lake in the Huachuca EMA, and Riggs Flat Lake in the Pinaleno EMA. Frye Mesa Reservoir in the Pinaleno EMA has been identified as having potential as a recreational fishery, but is not managed as such. Several small impoundments and numerous stock ponds are found throughout the Forest. There are no ground water basins on the Forest.

Environmental Consequences - Water Quality

Alternative 1: No Action

The No Action alternative would result in an increase in size and density of existing invasive plant populations. New populations and new species of invasive exotic plants would become established. Increases in tap-rooted species in the plant community result in increased surface runoff and sediment yield (Olsen 2001). This would adversely affect the quality of the surface water. Salt cedar populations, if allowed to expand, would potentially dry up springs and other riparian areas by lowering surface water tables through transpiration. In addition, salt cedar increases the salinity of surface soils, changing growing conditions for native plants.

In the group of plants identified for treatment in the proposed action, all are tap-rooted species except for the grasses (Lehmann lovegrass, buffelgrass, Johnson grass, giant reed). Lehmann lovegrass and buffelgrass have stabilized soils in areas where they have become established and have shown some utility for reclamation by decreasing surface flows and sediment yield. However, these grasses also increase fine fuels, making the occurrence of wildfire more frequent than in a native grass or desertscrub community. Soil stability may be temporary because increases in fire frequency may result in exposed soils following fires. Since these grasses aggressively reestablish after fire, the long-term effects would be to convert native desertscrub to grassland. The effects of this conversion, in combination with increasing fire frequency, on water quality are difficult to predict.

Alternative 2: Integrated Vegetation Management Except for the use of Herbicides.

Alternative 2 involves only non-chemical methods of plant control. This approach has been used to a minor degree on the Forest to date, with limited success. Effects to water from the non-herbicide weed control alternative would be similar to those displayed in Alternative 1. Weed populations would potentially spread more slowly than in Alternative 1, and hand pulling and grubbing activities would increase soil disturbance, increasing surface runoff and sediment yield to nearby streams in the short term. There would be no impact to ground water with this alternative. Because this alternative does not include the use of herbicides, there will be no effects to water quality from herbicide use.

Alternative 3: Integrated Vegetation Management.

Both direct and indirect water quality impacts can result from the use of herbicides to control vegetation. Direct adverse effects could result from improper applications for the following situations: (1) Waters receive herbicide from spray, drift, or spills; or (2) Large-scale applications to impervious surfaces and compacted soils, combined with runoff, could transport herbicides to water resources. However, the herbicides proposed for use are expected to have little to no negative impact on water quality if they are applied in accordance with registered label directions. Utilization of mitigation measures and safety practices (Chapter 3, Appendix D) will further reduce the potential adverse effects. To ensure proper application and to avoid problems related to runoff, all herbicide applications would be conducted by or under the supervision of a Certified Pesticide Applicator.

In areas of shallow bedrock, the potential for herbicides leaching through the soil profile and reaching water is greatest. However, several mechanisms prevent or retard the migration of herbicides through the soil profiles. These mechanisms include chemical precipitation, chemical degradation, volatilization, physical and biological degradation, biological uptake, and adsorption. Clays and organic matter in the soil adsorb (adhere to) certain organic compounds like herbicides (e.g. glyphosate). As a result, the ability of herbicides to leach through the soil column for entry to ground water would be reduced significantly (Table 10). A soil monitoring study of soil leaching conducted in Montana supports this expectation. For two years, clopyralid and picloram were monitored for their presence in the soil. Clopyralid was applied at 37 sites. Clopyralid was not detected below five centimeters at any site 30 days after application. Picloram was also monitored at 42 sites and one year after application detected at 16 ppb (parts per billion) at 5.25 centimeters with a trace detected below 25 centimeters (Rice et al. 1992).

The design of this alternative includes streamside buffer zones, described in Chapter 2, in which only certain herbicides may be used. Herbicide applications will be limited to spot and small scale treatments and will exclude aerial applications. Aquatically labeled formulations of 2,4-D and glyphosate can be safely applied up to the edge of water. These herbicides are short-lived, are not translocated through soil, or have other properties that allow safe use within the riparian zone. Clopyralid, dicamba, imazapyr, metsulfuron, picloram and sulfometuron cannot be safely applied adjacent to water and will not be used within the streamside buffer zone.

The area infested with invasive plant species currently is less than 1% of the Forest. Consequently, the area treated with herbicides each year is expected to be low. This further reduces the risk of surface or ground water contamination. Most of the analysis area receives less than 20 inches of precipitation per year. Consequently the likelihood of herbicide translocation to ground water is less than in higher precipitation zones.

Table 10. Potential for surface runoff and leaching for proposed herbicides (Vencill 2002)

Common Name of Herbicide	Solubility in Water (mg/L)	Half Life in Soil	Potential for Surface Runoff	Potential for Leaching
2,4-D	796 (salt)	10 Days	Low	Moderate
Chlorsulfuron	587 (pH 5) – 31,800 (pH 7)	40 Days	Low	Moderate at pH 7, but less at pH 6
Clopyralid	1,000 (acid) – 300,000 (salt)	40 Days	Low	Moderate
Dicamba	4,500 (acid) – 4000,000 (salt)	Less than 14 Days*	Low	Low to Moderate
Glyphosate	15,700 (pH 7) – 900,000 (salt, pH 7)	47 Days	Low	Low
Imazapic	2,200	120 Days	Low	Low
Imazapyr	11,272 (pH 7)	25-142Days*	Low	Low
Metsulfuron methyl	548 (pH 5) – 2,790 (pH 7)	30 Days	Low	Moderate at pH 7, but less at pH 6
Picloram	430	90 Days*	Moderate	High
Sulfometuron methyl	10 (pH 5) – 300 (pH 7)	20-28 Days	Low	Moderate at pH 7, but less at pH 6
Tebuthiuron	2.57	Over 360 Days*	Small	High
Triclopyr	23 (ester) – 2,100,000 (salt)	30 Days	Not Available	Not Available

*May persist significantly longer under conditions of low soil moisture and rainfall and soil types.

Under this alternative, hand-grubbing or pulling of weeds would occur, although to a lesser extent than under Alternative 2. Soil disturbance associated with this activity may contribute in the short term to sedimentation in water courses adjacent to the site of disturbance.

Changes in vegetative cover through the use of selective herbicides can have a substantial affect on protecting water quality. Removal of target noxious weeds and invasive plants, which are currently minor components of Forest vegetation, will favor establishment of native vegetation that will serve to intercept herbicide residues, other contaminants, and sediments.

Cumulative Effects – Water Quality and Quantity

Other past, present and future activities that would potentially contribute to cumulative effects to water quality in the project area include vegetation management, livestock grazing, off-road vehicle use and road maintenance. Selection of alternatives 1 and 2 would result in an increase in erosion and reduction in water quality. Whether this effect, in combination with other activities on the Forest, would result in significant effects is not known. Since the herbicides considered for use are short-lived and degrade in the environment and mitigations and BMP's will reduce the chances of herbicides moving into water, it is concluded that the typical application rates proposed under Alternative 3 will not contribute to any significant cumulative impacts to water quality.

Soil Quality (Issue #2)

Affected Environment

The analysis area for soils is the entire Forest. Units of measure for effects to soils are the degree to which each alternative increases or decreases soil quality.

Geology on the Forest is a highly diverse mixture of igneous rocks (granite), extrusive volcanics (rhyolite, basalt), metamorphic rocks (gneiss, schist, quartzite), and sedimentary rocks (limestone, shale, conglomerates). As a consequence, soils are highly diverse. In general, plant communities that have evolved on these soils are dominated by an understory of warm season bunchgrasses. Noxious weed infestations have been proven to increase soil erosion in bunchgrass ecosystems (Lacey 1989). However, because of the limited extent of invasive species on the Forest, soils on the Forest are not considered to be significantly affected by the presence of invasive species.

Soil quality is based on an interpretation of factors that affect the following three primary soil functions:

- Soil Hydrologic Function. This function is assessed by evaluating or observing changes in surface structure, surface pore space, consistence, bulk density, infiltration or penetration resistance using appropriate methods. Increases in bulk density or decreases in porosity results in reduced water infiltration, permability and plant available moisture.
- Soil Stability. Soil erosion is the detachment, transport, and deposition of soil particle by water, wind or gravity. Vascular plants, soil biotic crusts, and litter cover are the greatest deterrent to surface soil erosion. Visual evidence of surface erosion includes sheets, rills, and gullies; pedestalling, soil deposition, erosion pavement, and loss of the surface "A " horizon. Erosion models are also used to predict on-site soil loss.
- Nutrient Cycling. This function is assessed by evaluating the vegetative community composition, litter, coarse woody material, root distribution and soil biotic crusts. These indicators are considered an important source of soil organic matter, which is essential in sustaining long-term soil productivity. It provides a carbon and energy source for soil microbes, stores and provides nutrients which are needed for the growth of plants and soil organisms and by providing for cation and anion exchange capacities.

Environmental Consequences

Alternative 1: No Action

Conversion of native plant communities to invasive species monocultures results in simplification of ecosystems and replacement of fibrous-rooted native grasses with tap-rooted exotic species. Selection of Alternative 1 would result in the continued spread of invasive species on the Forest over the next 10 years. Plant communities would likely become more simplified as native plant communities are replaced by less diverse stands of invasives. Soils would be more vulnerable to erosion during storm events.

One response to scoping indicated that Lehmann lovegrass and buffelgrass have been used effectively to stabilize soils in disturbed areas, decreasing surface flows and sediment yield. However, these grasses also increase fine fuels, making the occurrence of wildfire more frequent than in a native grass community. Soil stability improvement may be temporary because of increases in fire frequency resulting in a denuded soil and a simplified plant community because these plants aggressively reestablish after fire. Buffelgrass in particular is invading the Forest in Sonoran desert plant communities that are not adapted to fire.

Alternative 2: Integrated Vegetation Management Excluding the Use of Herbicides.

Alternative 2 involves only non-chemical methods of invasive plant control. This approach has been used on the Forest to some degree to date. A four-acre infestation of Euryops in the Sabino Canyon Recreation Area was intensively treated by hand-grubbing in 1996, with repeated treatment efforts of varying intensity in subsequent years. The treatment was initially effective in greatly reducing the population, however, the effort could not reasonably be applied to the large (100 acre) population of Euryops on Frye Mesa. While burning may be an option for treating large infestations of Euryops and Pentzia, it would not be effective for treating Lehmann lovegrass or buffelgrass, which are opportunistic invaders after fire.

Hand pulling or grubbing results in soil disturbance at each plant and also provides an effective seed bed for germination of weed seed. Species such as Johnson grass and Canada Thistle are present on the Forest at a number of locations. These species have rhizomes, which are creeping, horizontal roots. These roots sprout when broken or fragmented. Thus mechanical control methods as prescribed in this alternative will likely result in maintenance of populations of this species, or more likely, its continued spread. This means that erosion and soil impacts will be increased due to invasive plant control measures and increased invasive plant populations. This alternative would slowly increase soil erosion over the next 10 years, with some areas of dramatic soil erosion possible in conjunction with mechanical control treatments. Manual control treatments may also result in increased loss of desirable native plant species, which further increases soil erosion.

Alternative 3: Integrated Vegetation Management.

This alternative would create less soil disturbance because invasive plants would often be sprayed instead of hand pulled or grubbed. This alternative would result in the most effective means of invasive plant management available and would stop or reduce the rate of spread of invasive species on the Forest. Because of less frequent use of soil disturbing weed management techniques and because native ecosystems with complex, fibrous root structures would be maintained, this alternative results in the least impact to soils on the Forest. This alternative would create the least amount of soil erosion of the three alternatives. Assuming that native plant communities will replace tap-rooted invasives after treatment, soil protection and nutrient cycling should be enhanced as a result of treatments.

Effects to Human Health (Issue 3)

Affected Environment

The analysis area for this resource is the Forest. Human health may be directly influenced when people utilize the Forest, and indirectly influenced by activities on the Forest that have some affect on adjacent human inhabited areas. An example of a direct influence on human health would be contracting giardia from drinking contaminated water while hiking. An example of an indirect influence would be having an asthma attack while at home as a result of breathing smoke from a wildfire on the Forest. Human use of the Forest is mainly associated with recreation, firewood harvest, use of grazing allotments and gathering of traditionally used plants. Currently human health on the Forest is not influenced by either the spread of invasive plant species or efforts to control them. Minor skin irritation may result from contact with thorny species or those that bear milky sap such as leafy spurge. Though some people may be allergic to the pollen produced by invasive plants, it is unlikely that invasive plants have been the primary source of seasonal or long-term allergies.

Units of measure for effects to this resource are the degree to which human health is affected by implementation of the alternative.

Alternative 1: No Action

The primary effect of the no action alternative will be the spread of invasive plants into the Forest. This is expected to have little direct effect on human health and safety. In terms of indirect effects, a slight increase in the potential for wildfires can be predicted as buffelgrass continues to spread into the Pusch Ridge Wilderness in the Santa Catalina EMA. A more frequent fire occurrence would result in indirect human health effects in the form of smoke in the Tucson area.

Alternative 2: Integrated Vegetation Management Except for the use of Herbicides

Impacts to human health and safety from mechanical and cultural treatments are likely to be minor. Possible effects include cuts, burns, allergies and skin irritation to individuals performing the work. Skin irritations may result as a result of contact with the sap or spines on the plants. Due to the uneven terrain in the vicinity of many of the treatment sites, minor injuries or falls may result. The use of personal protective equipment such as gloves, long sleeves and boots should minimize this risk. The effects of smoke described under Alternative 1 would likely occur under this alternative.

Alternative 3: Integrated Vegetation Management

The Southwestern Region has analyzed the risk to humans of the use of twenty-one herbicides and four carriers (USFS 1992) and individual risk assessments for the Forest Service for five herbicides and surfactants in the aquatic herbicide Rodeo (Pesticide-Use Advisory Memorandum No. 473 1995). In addition, a specific risk assessment for the herbicide imazapic is available. A comparison of the risk analysis conclusions are basically the same for the herbicides covered in the various risk assessments. The risk assessments prepared since 1995 can be obtained on a Forest Service web site (www.fs.fed.us/foresthealth/pesticide/health.htm). All of these risk assessments are incorporated by reference.

The Risk Assessment (USFS 1992) displays estimated risks to the public and the applicators when selected herbicides are used. The assessments display risks from "routine typical" and "routine extreme" cases. Routine typical cases represent risks to workers, the public, and other organisms that may occur as a result of routine operations. The routine extreme approach is used to estimate doses that would occur under conditions of maximum use and maximum exposure.

The Risk Assessment has three parts:

- The Exposure Analysis. This analysis estimates the range of possible doses to workers, the general public, aquatic organisms, etc. A variety of scenarios and exposure pathways are examined that could result in dermal and oral exposures.
- The Hazard Analysis. Tests and data related to the toxicity of herbicides are reviewed under this analysis. Data are reviewed to indicate the doses at which toxic effects occur and, conversely, levels at which no toxic effects are seen. Of particular interest is a value known as the "No Observed Effect Level" or NOEL. NOEL is the highest dose at which no adverse effects were noted in test animals.
- The Risk Analysis. Under this analysis, the dose levels calculated in the exposure analysis are compared to the NOEL levels to determine the effects of herbicides.

A considerable body of information from tests on laboratory animals is available for the herbicides considered for possible use in controlling noxious weeds. Most of these tests were conducted as a requirement for the U.S. Environmental Protection Agency (EPA) for the registration process. All of the herbicides proposed for use have been subjected to long-term studies that test for general systemic effects, effects on reproductive and developmental toxicity (birth defects), mutagenicity (change in genetic material), neurotoxicity (effect upon nerve tissue), carcinogenicity (tendency to produce cancer) and immunotoxicity (effect on the immune system). NOEL's are available for most types of these tests.

Extrapolating a NOEL from an animal study to humans is an uncertain process. The EPA compensates for the uncertainty by dividing NOEL's from test animals by a safety factor, typically 100, to derive a Reference Dose (RfD). In other words, the human RfD is $1/100^{th}$ of the NOEL for an animal study. The RfD, also know as the Acceptable Daily Intake (ADI) is defined as the daily exposure over a human lifetime (assumed to be 70 years) at which there is a reasonable certainty of no harm. The dose is expressed as milligrams of herbicide per kilogram of body weight per day (mg/kg/day). Acceptable reference doses for herbicides in this analysis are displayed in Table 11. Toxicity categories are defined by the U.S. EPA as follows:

Category I – Highly Toxic

Category II – Moderately Toxic

Category III – Slightly Toxic

Category IV – Relatively Nontoxic

Table 11. Acceptable Daily Intake (mg/kg/day) for selected herbicides and other compounds

Herbicide	Oral LD50 for rats (mg/kg)	ADI/RfD	Toxicity Category
2,4-D	375	0.3	II
Chlorsulfuron	>5,000	0.05	IV
Clopyralid	>5,000	0.5	IV
Dicamba	>5,000	0.03	IV
Glyphosate	>5,000	0.1	IV
Imazapic	>5,000	0.5	IV
Imazapyr	>5,000	**	IV
Metsulfuron methyl	>5,000	0.25	IV
Picloram	>5,000	0.07	IV
Sulfometuron methyl	>5,000	0.02*	IV
Triclopyr	>1,500	0.005	III
Aspirin*	750	**	III
Caffeine*	200	**	II
Ethyl alcohol*	13,000	**	III
Sugar*	30,000	**	IV
Table salt*	3,320	**	IV

*Included for comparison

**No reference dose is available or established.

In evaluating the potential impact of herbicides, it must be kept in mind the small amount that is typically used on National Forest System lands. This is normally less than 2 pounds per acre. Some products are applied at an ounce per acre.

Direct effects for workers are those that may occur from direct contact (dermal exposure) with a herbicide. Potential applications will be by backpack and ground based mechanical methods, and the area treated per day will be dependent on the specific site and the type of application. The proposed noxious weed treatments fall within the typical scenario for herbicide use considering the proposed application rates and acres treated per day per worker in the 1992 Risk Assessment. The conditions when a herbicide is applied will affect the exposure, and implementation of the mitigation measures covered in Chapter 2 will reduce possible exposures. Also, using personal protective equipment, as covered in the Safety and Spill Plan (Appendix D) will lower exposure of workers by as much as 68 percent (USFS 1992), since most application exposure is through the skin and not through the lungs by breathing vapors.

For the herbicides being considered for use, only 2,4-D poses a moderate risk of systemic effects for backpack applicators and ground mechanical applicator/mixer loader. In addition, dicamba has a moderate risk for reproductive effects. These risks would be mitigated by measures covered in the preceding paragraph and by limiting maximum exposure to these herbicides. Worker doses for the remaining herbicides proposed for use are likely to be well below the RfD if reasonable safety precautions are followed. The risks would be further reduced because the applicator would likely be exposed for a few days per year, at most. The RfD assumes a lifetime of daily doses.

There is the possibility that workers could receive dermal exposures from (1) the spill of a herbicide concentrate and (2) the spill of a herbicide mixture, including carriers. The risk to workers associated with accidental spills is expected to be low if they are trained, use required protective clothing and equipment, and follow steps outlined in the Safety and Spill Plan (Appendix D).

The Risk Assessment also evaluated the risk of exposure to common carriers used to apply herbicides. These include diesel oil, kerosene, limonene and mineral oil. The assessment determined that none of these carriers pose any risks to the public for systemic, reproductive or carcinogenic effects.

Concern has been raised about the collection and consumption of native herbs, medicinal plants, berries, etc., that could be inadvertently sprayed. The main concern appears to center on the increased risk of cancer that could result from exposure to low levels of a herbicide. All of the herbicides being considered for use have undergone testing for cancer. Clopyralid and dicamba tests have shown no evidence of cancer initiation or promotion. The evidence for 2,4-D and picloram has been debated. Nevertheless, the 1992 Risk Assessment assumes that the various herbicides are carcinogens. The analyses also assume that any dose of a carcinogen could cause cancer and the probably of cancer increases with increased doses. Estimates of the probably of developing cancer from exposure to these compounds are based on a conservative extrapolation from cancer rates in animals subjected to the chemical for a lifetime. The projected cancer rates are highest for workers since their doses could be higher. Cancer probabilities would increase by one in a million after spraying 2,4-D for 137 days or spraying picloram for about 11,000 days. Since the average American has about a one in four chance of developing cancer in his or her lifetime, the cumulative impact from spraying herbicides at the proposed rates is considered to be insignificant. Nevertheless, studies by the California Environmental Protection Agency, Department of Pesticide Regulation, for tribal people who gather plant materials for food, medicinal, ceremonial, or basketry purposes show that herbicides were no longer detectable or plant materials were no longer available after 80 weeks (www.cdpr.ca.gov). As a result, if and when treatments are done, information on the timing and location of spraying will be provided upon request to individuals who want to avoid these areas.

There is the possibility that a small percentage or the population in Arizona will be hypersensitive or allergic to one or more of the herbicides proposed for use. Symptoms exhibited by allergic individuals are caused by specific immunological reactions of the body that are triggered by exposure to very low doses of allergens. Allergic reactions result when the body's normal immune system defenses overproduce antibodies to specific foreign substances. Allergenic and hypersensitive reactions occur by different mechanisms than toxicity. Toxic reactions result when chemical doses become high enough to interfere with normal physiological functions of cells and tissues. Individuals who have allergic reactions or hypersensitivity are generally aware of their sensitivities and such people would not be permitted to work on spray crews. In addition, signing of treatment sites and public notices would be done to allow concerned members of the public to avoid any possibility of exposure from the proposed herbicide applications.

In summary, the risk or probability of harm to humans is not zero, but it is reasonable to expect that the human health impacts from the proposed herbicides applications would be insignificantly small.

Costs vs. Benefits of Treatments (Issue 5)

The productive value of the land is decreased by weeds that detract from or limit its productively, or increase operating and management costs. Although it is difficult to assess such economic impacts and few good studies are available, some general observations can be made concerning potential economic impacts cause by weeds. Economic losses of livestock from poisonous noxious weeds can be important, but this loss is relatively insignificant compared with losses from non-poisonous weeds. Most noxious weeds have lower forage value than native plants, primarily because most animals avoid them. Grazing capacity for wildlife and livestock can be reduced as much as 75 percent (Bucher 1984, cited in Olsen 1999). Invasive plants like cameltorn can grow up through cracks in asphalt causing increased maintenance costs. The loss of water in streams from heavy saltcedar infestations can have several impacts on downstream water users.

A study of the costs and efficacy of spotted knapweed management using integrated methods in Montana yielded the following results (Brown, et al 1998): (1) Tordon 22 at one pint per acre: 95 percent control of plants at $30.75 per acre; (2) Mowing: Zero percent plant control at $200 per acre; (3) hand-pulling: 25% plant control at $13,900 per acre. Data provided by the Arizona Department of Transportation for the Southwest Region's Environmental Assessment for the treatment of noxious weeds and hazardous vegetation on public roads on National Forest lands in Arizona (USFS 2003) are shown in Table 12. Based on the data available, it is likely that, on a per acre basis, the costs of treatment will be highest for Alternative 2, followed by Alternative 3. Under the No Action Alternative (Alternative 1), invasive plant control efforts will continue at current low levels, often using volunteer labor.

Table 12. Average costs for various vegetation control methods (ADOT)

Activity Description	Cost per Acre
Herbicide (off-road truck)	$37.83
Herbicide (off-road hand wand)	$87.03
Herbicide (hand application, liquid)	$151.95
Mechanical tree and brush removal	$177.23
Hand tree and brush removal	$195.84

The costs of treatments not only involve application costs, but according to comments received during scoping, potentially involve the costs of "contamination of water for human users and wildlife downstream, the degredation of fish habitat, clean up and remediation expenses in the event of a spill". While there is a minor potential for a spill to result in expensive clean up costs, this potential is reduced through the use of practices described in Chapter 2 and in the Safety and Spill Plan (Appendix D). As stated in the mitigation measures, herbicides will be used after it has been determined that they offer the only practical method of control.

Wilderness (Issue 7)

Affected Environment
The analysis area for this resource is the Forest, which has eight designated wilderness areas. Units of measure are change to wilderness character and change to wilderness user experience. There are 338,249 acres of designated Wilderness on the Forest. Only the Pusch Ridge Wilderness in the Santa Catalina EMA is affected by infestations of invasive plants to any significant degree. Populations of buffelgrass and fountain grass are spreading throughout lower elevation canyons on the southern slopes of the range adjacent to Tucson. In addition to these two grasses, African sumac has been documented within the wilderness. This species, and fountain grass, are widely planted in Tucson as ornamental landscape plants. Because of its proximity to the City of Tucson, the Pusch Ridge Wilderness is susceptible to invasion by escaped ornamental plants. Buffelgrass, while not planted as a landscape plant, is widely established throughout the Tucson basin and is increasing in the wilderness where suitable growing conditions exist.

Environmental Consequences

Alternative 1: No Action

Selection of the no action alternative would result in the spread of invasive plant species across the Forest, including in wilderness. While selection of this alternative would not preclude the future treatment of invasive plant populations in Wilderness, it is unlikely that the small, localized efforts that have occurred to date would be sufficient to check the spread of invasive plants, especially buffelgrass, in the Push Ridge Wilderness. Size of infestations, density of plants, total number of infested sites and number of invasive species would all increase. Native plant communities provide an important aspect of wilderness character. As native plant communities are replaced by invasive plant species, wilderness character would be lost. Viewing of native wildflowers and other plants would be diminished and the conversion of a diverse native plant community to a monoculture of exotic grass would reduce the quality of the wilderness user experience. Buffelgrass has been shown to cause an unnatural buildup of fine fuels in Sonoran desert ecosystems that are not adapted to fire. The frequency and intensity of fires in infested sites is expected to increase over the term of the analysis. Buffelgrass reproduces rapidly following fires, so frequently occurring fires would only encourage the spread of this species.

Alternative 2: Integrated Vegetation Management Excluding the use of Herbicides.

Manual, mechanical control of invasive plant species will slow the rate of spread of some of invasive plant species in wilderness. As populations of invasive species become more common in the areas outside wilderness on federal and private lands, it will become increasingly difficult to prevent their introduction to wilderness. Control with manual and mechanical means will also become more difficult, time consuming and expensive. Increased new populations of invasive species will therefore tax Forest budgets and manpower. When species like buffelgrass and fountain grass are introduced to wilderness, non-chemical control methods will most likely fail to control them, since the species are prolific seed producers and can grow on steep, rocky slopes that are difficult to access on foot. Non-chemical control methods will also cause significant soil disturbance and loss of desirable native vegetation because of extensive digging during attempts to grub out roots of invasives. Disturbed soil will provide a seed germination surface that will encourage production of more of the problem species. Invasive plants would not be eliminated from wilderness, but rather become a permanent fixture there. Wilderness character and quality of the user experience would both be degraded by selection of this alternative, although the rate at which this change occurred would be slower than in alternative 1.

Alternative 3: Integrated Vegetation Management

Selection of the IVM alternative would allow the use of all available methods for management of invasive species. Some challenges will still occur under this alternative in that invasive plant populations must be detected before they may be controlled, and the remote character of the wilderness setting may make detection difficult. Training of volunteers and employees to quickly locate and report invasive species and quick management response would greatly improve the success of this alternative. Appropriate timing of treatments and careful selection of the best method will also be critical for this alternative to succeed. Use of herbicides in wilderness will require the FS-2100-2, or pesticide use proposal to be signed by the Regional Forester.

Some disruption of wilderness use while invasive plant control measures are implemented will occur. Presence of dead plants may reduce wilderness experience for some users in the short term. Long term protection of wilderness character and user experience would be optimized with this alternative.

Failure to protect wilderness character through lack of invasive plant management is inconsistent with the Wilderness Act of 1964 which designates that wilderness areas are "recognized as an area where the earth and its community of life are untrammeled by man" and is "protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable." Alternative 3 is consistent with this law in that it allows use of herbicides to control invasive plant species where appropriate as well as other methods. Non-chemical control methods may be used to effectively manage small infestations of some invasive species that don't have extensive root systems that will sprout from remaining fragments, but will produce areas of bear disturbed soil which will readily provide a seed bed for invasive plant seed already on-site.

Cumulative Effects -Wilderness

Past, present and foreseeable future activities that may contribute to cumulative effects to wilderness include wildfire, increased wilderness use, construction of new trails and trail maintenance activities. Selection of alternatives 1 and 2 would contribute to cumulative effects to wilderness through failure to effectively manage invasive plant infestations. Impacts as a result of alternative 2 would occur more slowly than in alternative 1. Selection and implementation of alternative 3 would result in minor restrictions on wilderness use, but would not contribute to any cumulative effects on wilderness.

CHAPTER 4 - CONSULTATION AND COORDINATION

In addition to the numerous individuals and groups that participated in the review of various reports and drafts, the following individuals participated in the environmental analysis and preparation of the environmental assessment:

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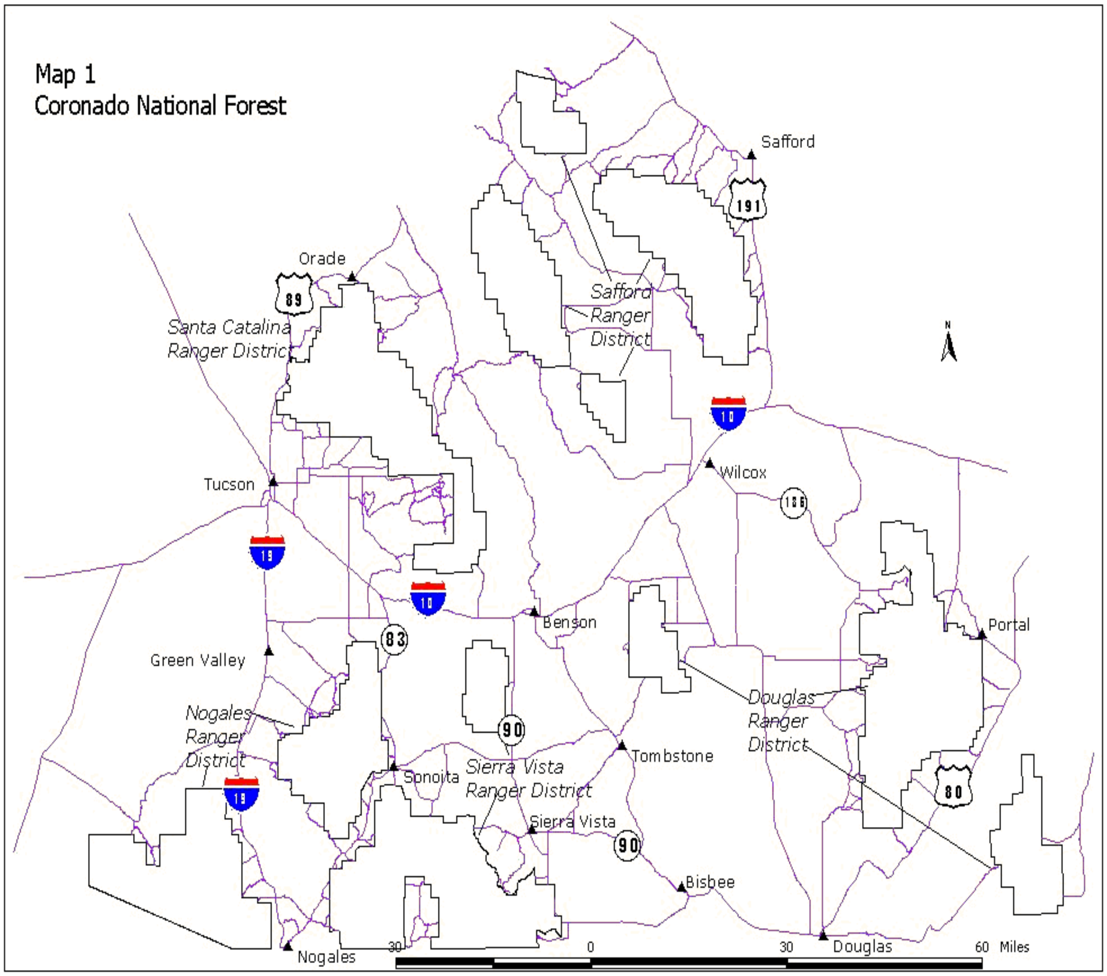
Acronyms Used in the Environmental Assessment

ADI: Acceptable Daily Intake
APHIS: Animal and Plant Health Inspection Service
ARS: Arizona Revised Statutes
ATV: All Terrain Vehicle
BLM: Bureau of Land Management
CCC: Civilian Conservation Corps
CEQ: Council on Environmental Quality
CFR: Code of Federal Regulations
EA: Environmental Assessment
EMA: Ecosystem Management Area
EPA: Environmental Protection Agency
FSH: Forest Service Handbook
FSM: Forest Service Manual
GIS: Geographic Information System
IBA: Important Bird Area
IVM: Integrated Vegetation Management
LC_{50}: Lethal Concentration
LD_{50}: Lethal Dose
LRMP: Land and Resource Management Plan
MIS: Management Indicator Species
NEPA: National Environmental Policy Act
NMSA: New Mexico Statutes Annotated
NOEL: No Observable Effect Level
NRCS: Natural Resources Conservation Service
PL: Public Law
PPE: Personal Protective Equipment
PR: Project Record
PUP: Pesticide Use Proposal
RfD: Reference Dose
RNA: Research Natural Area
SCS: Soil Conservation Service
TEPS: Threatened, Endangered, Proposed and Sensitive (also TES)

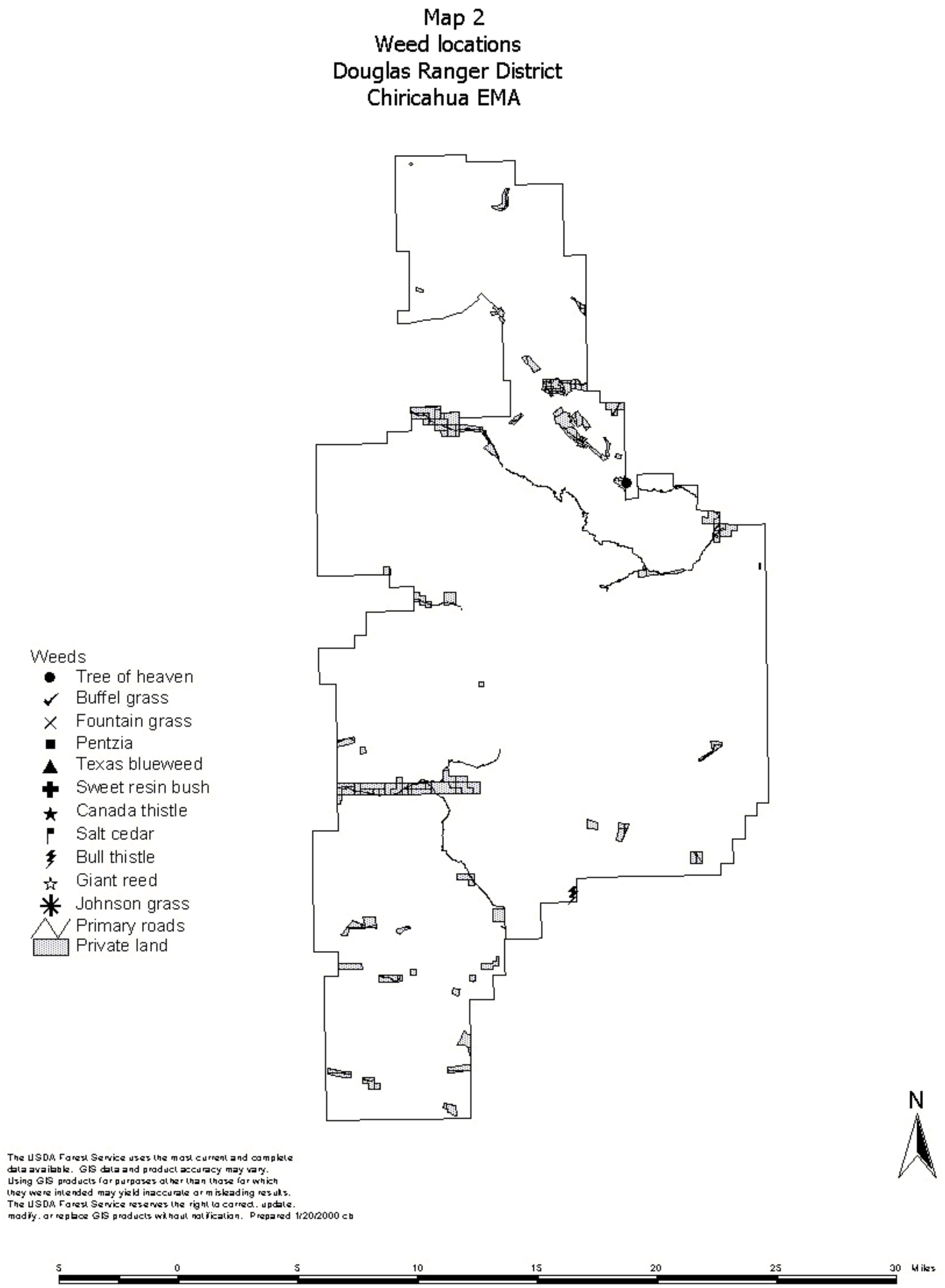
TMDL: Total Maximum Daily Load
USC: United States Code
USDA: United States Department of Agriculture
USFS: United States Forest Service
WMA: Weed Management Area

MAPS

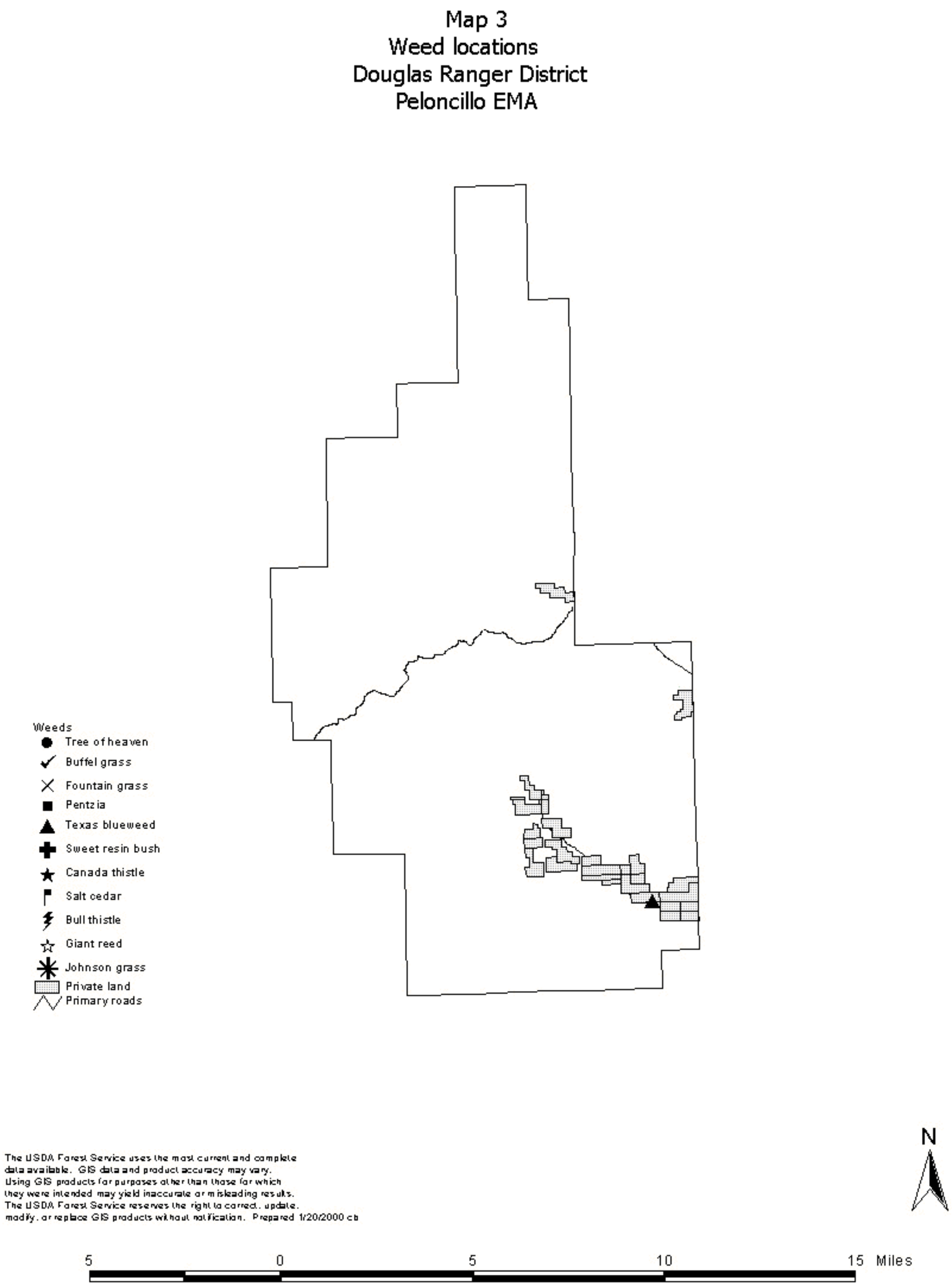
Map 1: Project area



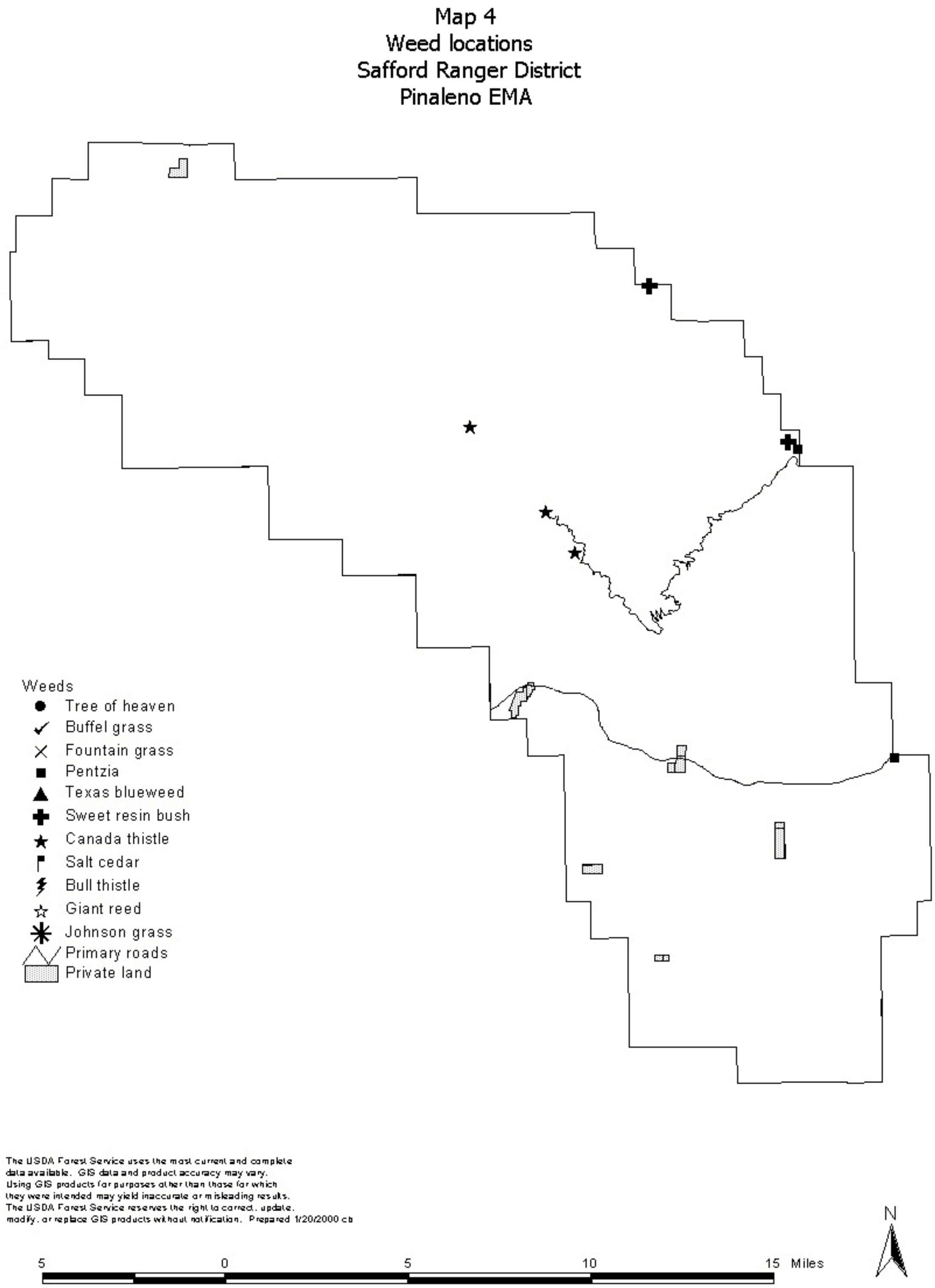
Map 2: Chiricahua EMA



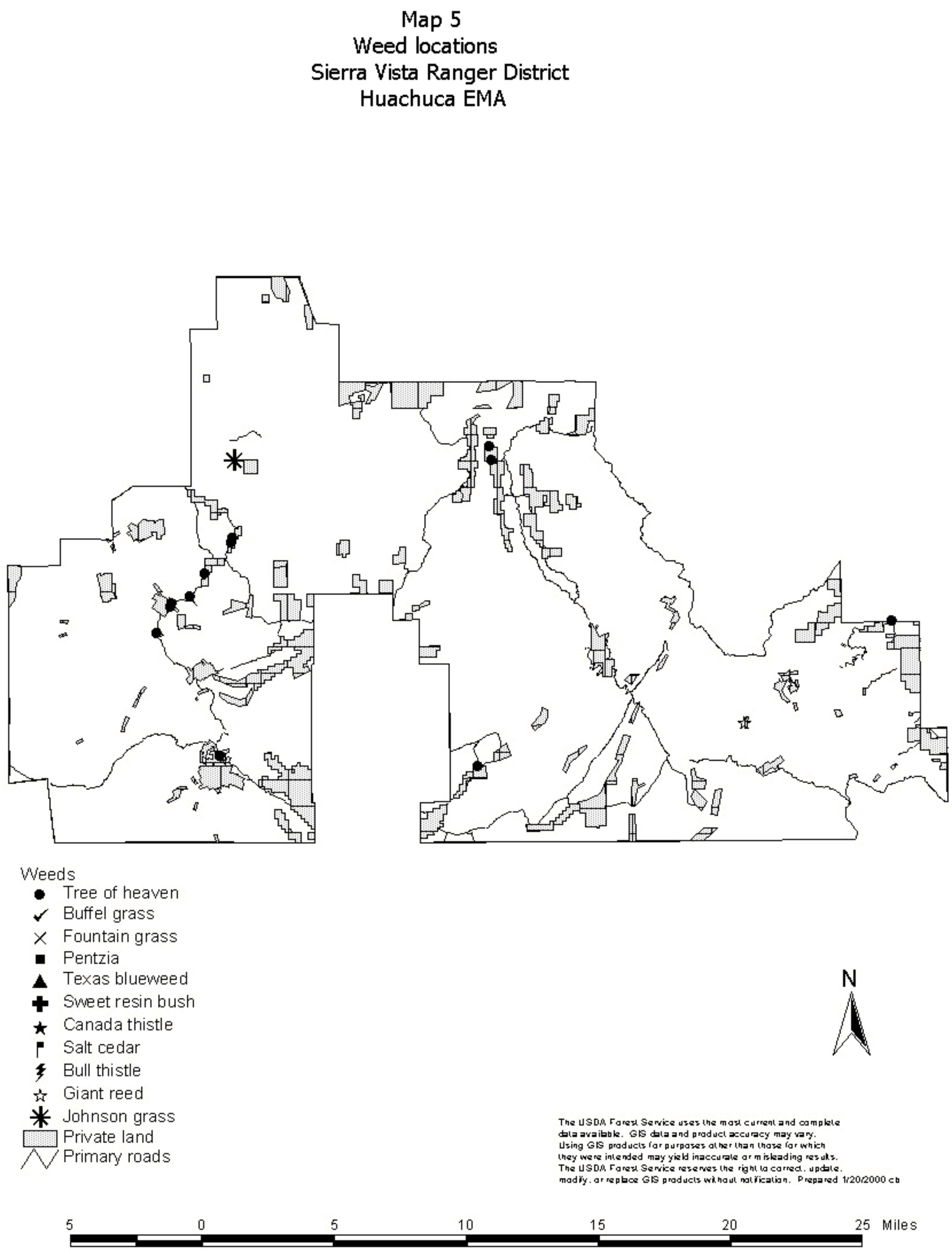
Map 3: Peloncillo EMA



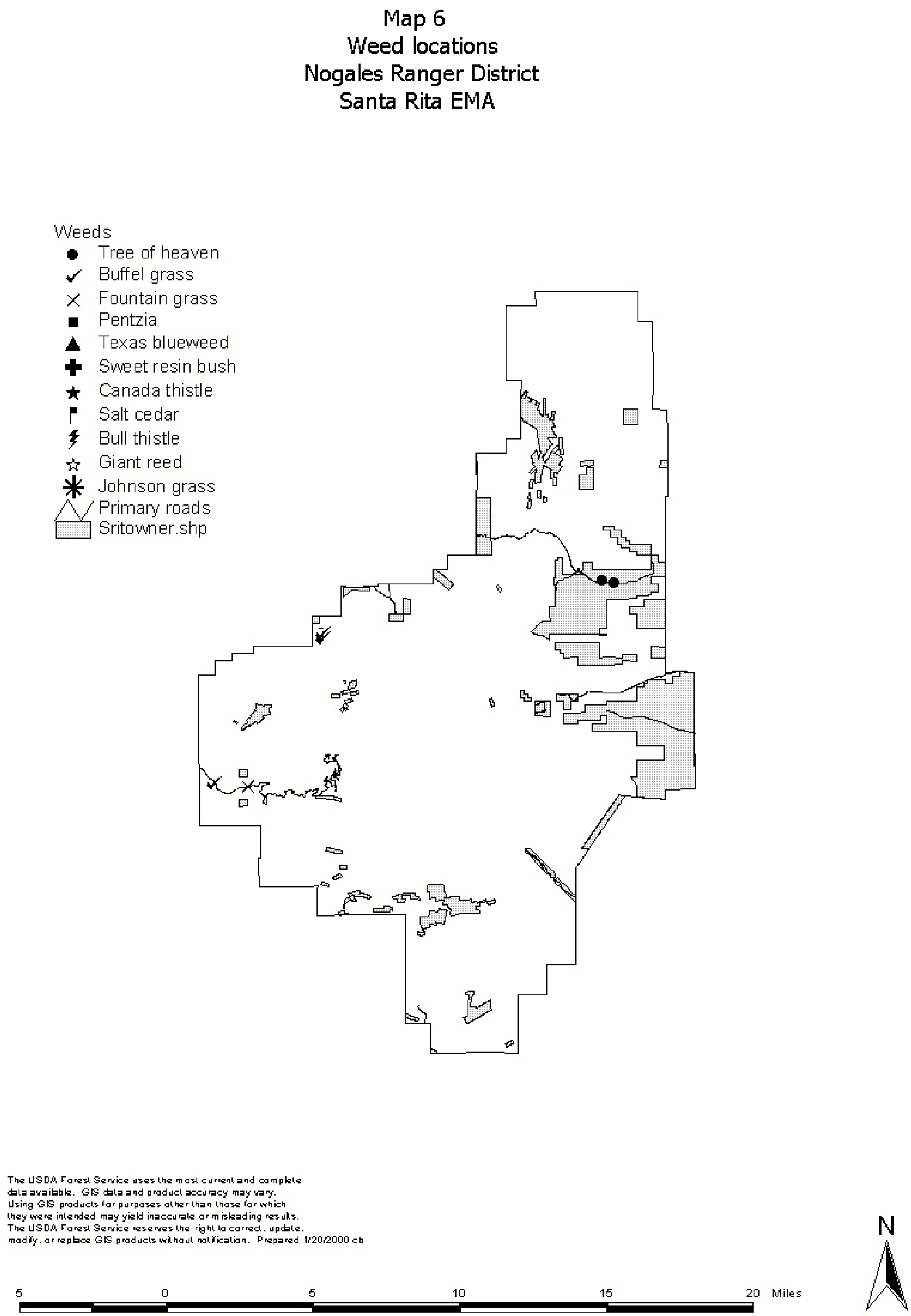
Map 4: Pinaleno EMA



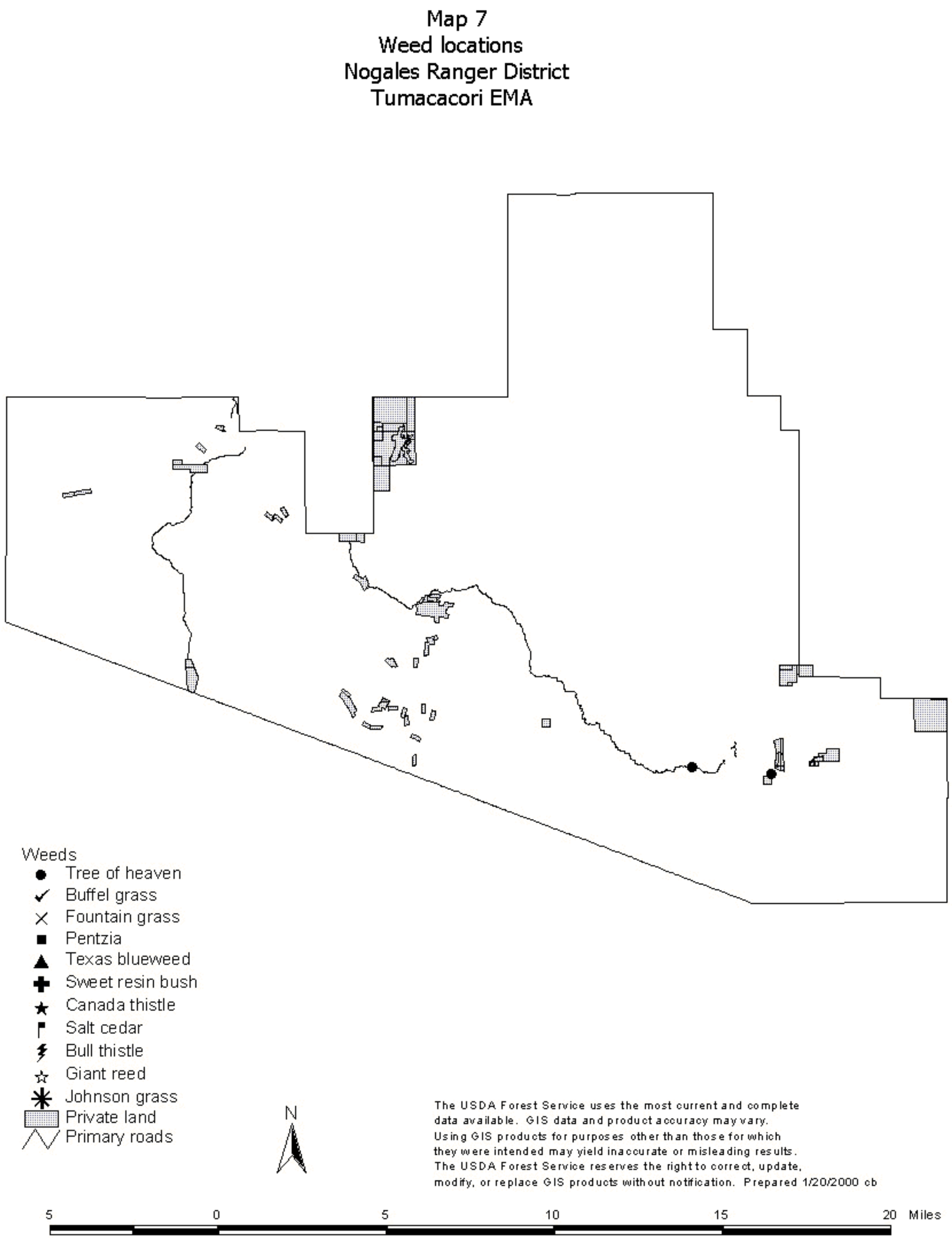
MAP 5: HUACHUCA EMA



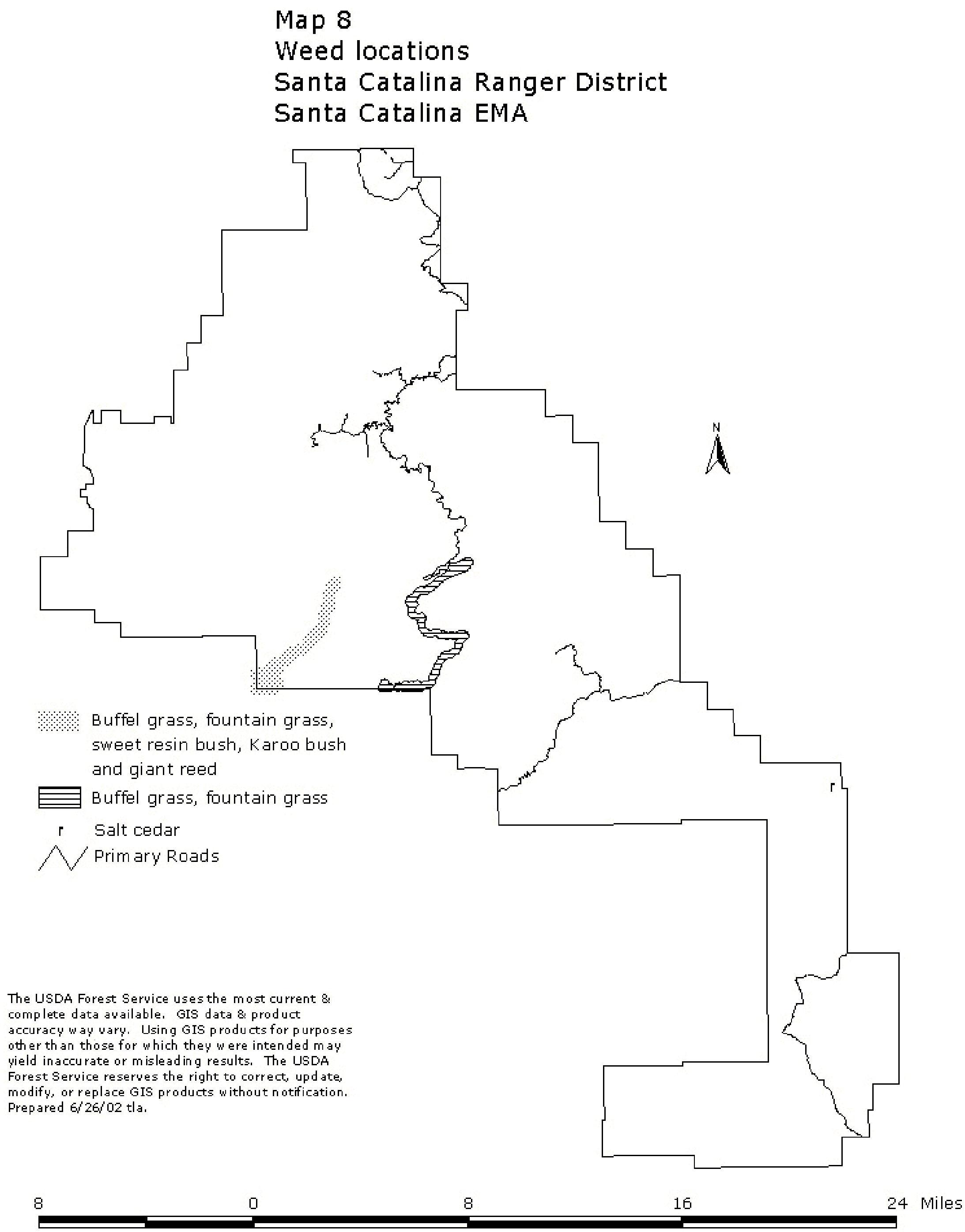
Map 6: Santa Rita EMA



Map 7: Tumacacori EMA



Map 8: Santa Catalina EMA



APPENDICES.

Appendix A.

Herbicides proposed for use in the Coronado National Forest Integrated Vegetation Management Program.

Herbicides proposed for use include those with 2,4-D, chlosulfuron, clopyralid, dicamba, glyphosate, imazapic, imazapyr, metsufuron, picloram, sulfometuron methyl, triclopyr or tebuthiron as their active ingredients. These herbicides are marketed under a variety of trade names. The Environmental Protection Agency (EPA) has approved all of these herbicides for controlling noxious weeds and requires that any use restrictions be included in the product label.

Most of the products available for use are translocated, selective herbicides. They are absorbed into plant tissue through leaf, stem or bark surfaces and through the roots. These chemicals concentrate in the metabolically active tissues of the plant, altering plant growth. These selective herbicides kill broadleaved plants, or dycots, or a selection of plant families within the dycots, depending on the herbicide used and the rate at which it is applied. Glyphosate and imazapyr are non-selective herbicides, and will kill both dycots and monocots, which are grasses and parallel-veined plants like lilies and orchids. The chemical selected and the rate at which applied, as well as the timing of application all determine which species will be killed. Glyphosate is absorbed primarily through plant leaves and stems, rather than roots. This chemical bonds tightly to soils and is not available to plants in the rooting zone.

All of the herbicides proposed for use in this alternative, except 2,4-D, are rated by the EPA as slightly toxic (toxicity class III) to humans or almost non-toxic (toxicity class IV). 2,4-D is rated as moderately toxic (toxicity class II). Plants and humans have different metabolic pathways. Therefore, chemicals that have toxic properties to plants don’t have the same effects on humans. Insects and humans have similar metabolic pathways and many insecticides are also very toxic to humans. No insecticides are proposed for use in this project.

Each herbicide proposed for use is described in more detail below.

Herbicide: 2,4-D
Brand Name: *Esteron 99C, Weedone LV4, Weedone LV6* and others
This is one of the most commonly used home and garden herbicides in the United States, and it is one of the most extensively studied. It is a selective, foliar (leaf) absorbed, phenoxy herbicide that targets annual and perennial broadleaf weeds. This herbicide degrades quickly; the average field half-life is 10 days. This herbicide targets broadleaved vegetation, but usually requires several applications due to its short persistence. The action that kills plants mimics natural plant hormones. Plants are most susceptible when they are young and growing rapidly. An important utility of 2,4-D is in riparian areas for products with an aquatic label.

Herbicide: Chlorsulfuron.
Brand Name: *Telar*
This is a selective pre-emergence or early post-emergence herbicide used at very low rates, ½ to 3 ounces per acre. It is in a group of herbicides called sulfonyureas. Its action in plants is described as a rapid mitotic inhibitor. It is a dry flowable material that is mixed in water and applied as a spray to control many annual, biennial, and perennial weeds on non-crop sites. It is very soluable in water and mobile; thus, it will not be considered for use in buffer zones near water. It has a soil half-life of 30 days.

Herbicide: Clopyralid
Brand Name: *Transline*, *Stinger*, *Reclaim*
This is a selective, post-emergence herbicide that is mainly used to control broadleaf species in three plant families: composites (Asteraceae), legumes (Fabaceae), and buckwheats (Polyganaceae). Its selectiveness makes this herbicide a useful material for control of invasive plants like Pentzia and sweet resin bush while preventing adverse effects to many native species. Grass species are especially tolerant to clopyralid. This herbicide is readily absorbed by roots and foliage readily transported in plant tissues. The material has moderate persistence, high mobility, and high leaching potential. Thus, it will not be used within designated buffer zones along streams or near water in compliance with label requirements. It also can be purchased in mixtures with other herbicides: ***Curtail***, clopyralid with 2,4-D; and ***Redeem***, clopyralid and triclopyr. Mixing with other products decreases the selectivity of this herbicide.

Herbicide: Dicamba.
Brand Name: *Vanquish, Weedmaster*
Dicamba is a broad spectrum herbicide for broadleaved plants. It is a growth-regulating herbicide readily absorbed and translocated from either roots or foliage. This herbicide produces effects similar to 2,4-D. It has moderate persistence (half-life in soil of 14 days to 12 weeks, Ahrens et al 1994), high mobility, and high leaching potential. This herbicide would not be used within buffer zones near water or areas identified as shallow and sensitive aquifers. Since it can move in surface runoff, it would not be used where impervious surfaces (compacted earth) exist proximal to water. However, the use of vegetated buffer zones would mitigate the risk of runoff-related contamination to surface water sources. Dicamba can be mixed with 2,4-D to increase its effect on certain plants.

Herbicide: Glyphosate.
Brand Name: Roundup, Rodeo
This is a non-selective herbicide that controls virtually all annual and perennial weeds, but it is generally most toxic to annual grasses. Since this herbicide kills a broad spectrum of plants, care is needed to limit adverse effects on non-target plants. It works by inhibiting amino acid pathways in plants. Theses amino acid pathways are not found in animals, which means that the herbicide has relatively low toxicity to humans. The compound is absorbed by foliage, but rainfall within six hours may reduce effectiveness. It has no soil activity. Persistence and mobility are low, and the compound tends to adhere to sediments when released into water. ***Rodeo*** is an aquatically labeled formulation considered safe for aquatics because toxic inert ingredients, such as surfactants have been left out of this formulation.

Herbicide: Imazapic
Brand Name: *Plateau*.
This herbicide also is considered to be non-selective, although the rate of application and the timing of application can provide some selectivity. Many native grasses and wildflowers are tolerant of this herbicide at lower rates of application, while annual weedy species are susceptible. It destroys weeds by blocking the pathway which produces branch chain amino acids in plants. As with glyphosate, animals do not have such pathways, and the compound has low toxicity to humans. This herbicide is particularly effective for control of leafy spurge and perennial pepperweed.

Herbicide: Imazapyr
Brand Name: *Arsenal*.
This herbicide is non-selective and it provides pre-emergence and post-emergence control, including residual control, of a variety of grasses, broadleaf weeds, and woody plants. It is particularly useful for control of saltcedar. Half-life in soil ranges from 25-142 days, depending on soil type and environmental conditions (Ahern 1994). Foliar absorption usually is rapid (within 24 hours).

Herbicide: Metsufuron.
Brand Name: *Escort*.
This is another sulfonyurea herbicide that is primarily absorbed through the foliage. It interrupts a biological process necessary for plant growth. It is a powder that is mixed with water and applied at very low rates (1-3 ounces per acre) for control of a variety of weed species, including such difficult to control species as hoary cress (whitetop) and perennial pepperweed. It is moderately residual in soil with a typical half-life of 30 days (Ahern 1994).

Herbicide: Picloram
Brand Name: *Tordon*
Picloram is an organic compound that is a plant growth regulator used for controlling unwanted broadleaf vegetation on rangelands and forested sites. Grasses are generally not killed by this herbicide. The herbicide also is considered to be rate-selective, meaning that the plant species killed varies with the rate of application. At one pint per acre, picloram kills knapweeds while leaving many native species unharmed. At one quart per acre, this herbicide kills many more plant species. This is the only "restricted use" herbicide proposed for use, and the purchase and application of this compound can only be done under the direction of a certified pesticide applicator with a valid license. The restriction is due to the persistence of this product, which has an average soil half-life of 90 days (Ahern 1994), although it can persist for a longer period of time. Its persistence makes it particularly useful for control of weeds, but it must be used in such as way that is does not contaminate water. This herbicide should not be applied to cobble or gravel soils or to areas with a shallow water table.

Herbicide: Sulfometron methyl (Sufometuron)
Brand Name: *Oust*
This is another sulfonyurea herbicide that has broad-spectrum properties. It is a powder that is mixed with water and it is toxic to target plants at very low rates. It is readily

absorbed by roots and foliage; thus, it is used as a pre-emergent and post-emergent herbicide.

Herbicide: Triclopyr
Brand Name: *Garlon 3A* and ***Garlon 4***
This herbicide is selective and it is especially useful for trees and woody shrubs such as saltcedar. It acts by mimicking the activity of auxin, a natural growth hormone. The active ingredient is readily absorbed by foliage. Average half-life in soil is 30 days (Ahern 1994). Triclopyr is also mixed with clopyralid and marketed under the product name of ***Redeem***.

Herbicide: Tebuthiuron
Brand Name: *Spike*
This herbicide can be used in pastures and rangelands, in non-crop situations, for control of certain broadleaf weeds and woody species. It is persistent in soil with a half-life of 12-15 months. This makes this compound particularly useful for difficult to control species like camelthorn.

Appendix B.

Pesticide Use Proposal

Appendix C.

Guide to Noxious Weed Prevention Practices

Appendix D.

Safety and Spill Plan

The following information will be reviewed by all workers who handle herbicides.

Information and Equipment

A copy of the Labels and Material Safety Data sheets for herbicides being used will be available at all times during project operations. All personnel involved in the handling of pesticides will review and be familiar with relevant Material Safety Data Sheets.

Required Personal Protective Equipment (PPE) will be worn at all times when herbicides are being mixed and applied. Label requirements for specific herbicides will be followed. Applicators and handlers must wear the maximum PPE required by the labels of each herbicide being applied.

An emergency spill kit, with directions for use, will be available when herbicides are being mixed, transported and applied. Employees will be trained in the use of the spill kit prior to initiation of operations. The spill kit will contain the following equipment:

- Shovel
- Broom
- Ten pounds of absorbent material
- Box of large plastic garbage bags
- Safety goggles
- Rubber gloves

Procedures for Mixing, Loading and Disposing of Chemicals

The following procedures will apply to all herbicide applications:

1. Mixing of herbicides will occur at least 100 feet from well heads or surface waters.
2. Dilution water will be added to the spray container prior to addition of the spray concentrate.
3. Hoses used to add dilution water to spray containers will be equipped with a device to prevent back-siphoning, or a minimum 2-inch air gap.
4. Only those quantities of herbicides needed for one day's use will be mixed.
5. Those workers mixing chemicals will wear personal protective equipment required by the label.
6. Empty containers will be triple rinsed. Rinsate will be added to the spray mix or disposed of at the application site at rates that do not exceed those on the label.
7. Unused herbicides will be stored in a locked building in accord with herbicide storage instructions provided by the manufacturer and in accordance with Arizona Structural Pest Control Commission Regulations.

8. Empty and rinsed herbicide containers will be punctured and disposed of according to label directions.

Procedures for Herbicide Spill Containment

In the event of a spill, immediately notify the project supervisor. Identify the nature of the incident and extent of the spill, including the product name(s) and chemical registration number(s).

Remove any injured or contaminated person to a safe place. Remove contaminated clothing and follow MSDS guidelines for emergency first aid procedures following exposure. Obtain medical help for any injured employee.

Minor Spills (Less than 1 gallon of herbicide formulation or less than 10 gallons of herbicide mixture).
Areas where chemicals are spilled will be roped off or flagged to warn people and restrict entry. Qualified personnel will always be present on the site to confine the spill and warn of danger until it is cleaned up. The spill will be confined with earthen or sand dikes if the chemical starts to spread. The spill will be soaked up with absorbent material such as sawdust, soil, or clay. Contaminated material will be shoveled into a leak proof container for disposal and labeled. Contaminated material will be disposed of using the same method as for herbicides. The spill area will not be hosed down.

Major Spills (More than one gallon of herbicide formulation or more than 10 gallons of herbicide mixture).
Areas where chemicals are spilled will be roped off or flagged to warn people and restrict entry. Qualified personnel will always be present on the site to confine the spill and warn of danger until it is cleaned up. The spill will be confined with earthen or sand dikes if the chemical starts to spread. The spill will be soaked up with absorbent material such as sawdust, soil, or clay.

The local fire department and State pesticide authorities will be notified. Follow their instructions for further action.

If the spill occurs on a highway, the highway patrol or sheriff will be notified. Whenever possible, someone familiar with the situation will remain at the site until help arrives. Emergency phone numbers will be carried by the herbicide applicators.

Reporting

Spills should be reported following procedures outlined in FSH 2109.14, Pesticide Use Management and Coordination Handbook. The following list is a guide for the information regarding spills that should be reported. Incidents should be reported even if there is doubt as to whether the spill is an emergency or whether someone else has reported it.

Date:
Time of Release:
Time Discovered:
Time Reported:

Duration of Release:
Location: (State, county, route, milepost)
Chemical name:
Chemical identification number:
Chemical data:
Known health risks:
Precautions to be taken:
Cause and source of release:
Estimated quantity (gallons) released:
Quantity (gallons) which has reached water:
Name of affected watercourse:
Number and type of injuries:
Potential future threats to environment or health:
Your name:
Telephone numbers:
Address:
Name and address of the carrier:
Truck or vehicle number:

Appendix E.

Biological Assessment and Evaluation

Appendix F.

Management Indicator Species on the Coronado National Forest

	Group	Species
1	Cavity Nesters	Coppery-tailed (Elegant) Trogon Sulphur-bellied Flycatcher Other primary and secondary cavity nesters*
2	Riparian Species	Gray hawk, Blue-throated hummingbird, Coppery-tailed (elegant) trogon, Rose-throated becard, Thick-billed kingbird, Sulphur-bellied flycatcher, Northern Beardless tyrannulet, Bell's vireo, Black bear
3	Species Needing Diversity	White-tailed deer, Merriam's turkey, Coppery-tailed (elegant) trogon, Sulphur-bellied flycatcher Buff-breasted flycatcher, Black bear
4	Species Needing Herbaceous Cover	White-tailed deer, Mearn's quail, Pronghorn antelope, Desert massassauga, Baird's sparrow
5	Species Needing Dense Canopy	Bell's vireo, Northern beardless tyrannulet, Gray hawk
6	Game Species	White-tailed deer, Mearn's quail, Pronghorn antelope, Desert bighorn sheep, Merriam's turkey, Black bear
7	Special Interest Species	Mearn's quail, Gray hawk, Blue-throated hummingbird, Coppery-tailed (elegant) trogon, Rose-throated becard, Thick-billed kingbird, Sulphur-bellied flycatcher, Buff-breasted flycatcher, Northern beardless tyrannulet, Five-striped sparrow
8	Threatened and Endangered Species	Desert bighorn sheep, Gray hawk, Peregrine falcon, Blue-throated hummingbird, Coppery-tailed (Elegant) trogon, Rose-throated becard, Thick-billed kingbird, Sulphur-bellied flycatcher, Buff-breasted flycatcher, Northern beardless tyrannulet, Bell's vireo, Baird's sparrow, Five-striped sparrow, Mexican stoneroller, Arizona (Apache) trout, Gila topminnow, Gila chub, Sonora chub, Spikedace, Desert massassauga, Twin-spotted rattlesnake, Arizona ridge-nosed rattlesnake, Huachuca (Sonora) tiger salamander, Tarahumara frog, Western barking frog, Arizona treefrog Mt. Graham spruce (red) squirrel, Gould's turkey